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Engineers' Part in Belgian Relief

TWO AMERICAN engineers, as chairman and vice-chairman respectively of the Commission for Relief in Belgium, have been mainly responsible for the prompt and effective manner with which that great work has been carried out. There is nothing especially significant, in an engineering sense, in the selection of these men, for they were chosen without regard to their profession. The results attained, however, speak eloquently of the organizing ability of engineers, as all will agree after reading the article on page 537 of this issue. To-day the relief work in Belgium is being carried on in an almost machine-like manner, so well was it planned and so effectively put under way. It is but proper that Herbert C. Hoover and Lindon W. Bates be given due credit for their part in this great humanitarian enterprise.

Co-operation for Sewage Tests

IF THE FULLEST benefits are to accrue from the experimental treatment of sewage by the activated sludge process at Baltimore there should be a hearty response to the request for criticisms and suggestions, made by Leslie C. Frank and Calvin W. Hendrick in the article on page 521 outlining the proposed plan of operating the aero tanks. The authors set forth the principles underlying the design of the continuous-flow type of tank which is to be used, and state clearly the objects which are sought in the experimental work. While other investigators in this country have made some progress along the line of sewage treatment by aeration, the subject is comparatively new and it is particularly desirable, therefore, that such information as is available be placed at the disposal of the Baltimore investigators. Thus it will be possible to avoid duplication of work and to concentrate effort on the solution of those elements of the problem which the general opinion indicates to be deserving of most attention.

Aqueduct Nearing Completion

A BILL introduced recently in the New York State Legislature confers upon the Board of Water Supply of New York City the same powers for preventing pollution on the Catskill watersheds as is now vested in the Department of Water Supply, Gas and Electricity with respect to the Croton supply. The measure has a double significance. Aside from its obvious purpose of safeguarding the purity of the water which the new aqueduct will carry, it indicates that the great waterworks system is well along toward completion. To the minds of those who have followed its progress for the last ten years or so, the Catskill aqueduct always suggests a picture of construction on a large scale. It is hard to realize that it will soon be time to revise this conception and to think of the aqueduct in terms of operation and maintenance. Incidentally, it may be noted that the recent decision confirming the purity of the Owens River water removes the last obstacle preventing unhampered use of the Los Angeles aqueduct—a project that has been particularly unfortunate in the attacks made upon it. Its builders deserve well of the people of Los Angeles, and it is gratifying to know that the mooted questions are now settled.

Aiding the Fly

WERE the effects not so serious, one would be tempted to smile ironically at the foibles of people who pay taxes to rid their alleys of filth, and then turn traitor to themselves and, as soon as the cleaners leave, throw rubbish and filth into their recently cleaned thoroughfares. Such procedure is sure to promote disease through the breeding place provided for contagion-bearing flies. In order to awaken some of the people of Detroit to their negligence, George H. Fenkell, commissioner of public works, has issued a pamphlet which contains information concerning the cleaning of alleys. Each page is illustrated with photographs, which silently but powerfully bring home to the reader conditions as they are. One photograph shows an alley after being cleaned; on the opposite page is a view of the same alley, two days later, showing how badly the citizen has failed in his duty to co-operate with the cleaners. The persons responsible for the accumulation of filth should be, under the law, as guilty of a misdemeanor as the man who spits on the floor of a street car. In many cases alleys are obstructed by old wagons, barrels and piles of ashes which prevent the operation of alley machine sweepers, with which, by the way, Detroit has recently provided itself. Mr. Fenkell's pamphlet is instructive, to the point, and powerful in its appeal. Other cities and towns could well afford to adopt some similar method of awakening the interest—or arousing the shame—of the untidy residents.

Unemployment Speeds Up Courts

VIGOR in pushing construction work is usually displayed by those who have money to spend and want to shorten the period between the date of appropriation for a project and the time when it can begin to earn. Municipal authorities and courts on which expenditures depend do not, with a few exceptions, work at high pressure. The earning capacity of a new sewer system cannot be measured. A filtration plant can save lives, which may be capitalized at so much per head, but the monetary advantage of completing a pavement a month ahead of the schedule is not so easy of calculation. Another and apparently much more powerful incentive to push municipal work to an early completion has arisen this year. To get work for the unemployed, Judge Scully, of Chicago, head of the county court system, has announced that special assessment cases relating to street improvements would be rushed as fast as the dignity of the courts will permit. More than 800,000 sq. yd. of paving are involved in the assessment rolls pending judicial confirmation, and rolls for about 500,000 cu. yd. more are in the office of the Board of Local Improvements awaiting advertisement and award of contract. Unemployment has forced the judges and other officials to proceed more rapidly than is their custom. It is to be hoped that the more expeditious procedure will be adopted as standard.

Maltreating Water Filters

IF ADDITIONAL evidence were needed to demonstrate the utter folly of dispensing with skilled supervision over the operation of water purification plants it may be found in last week's issue, page 500, in a letter to the editor entitled "Filters Balk at Operating Methods of City Fathers." The novel feature in this case, however, is not that slow-sand filters were placed in the hands of an untrained operator and clogged up, but that a committee of the city council, headed by a nose and throat specialist, undertook to correct the trouble. It goes without saying that no sanitary engineer was called in to advise as to the best methods of procedure. This committee, seeing the clogged sand, apparently remembered the Biblical injunction, "If thy right eye offend thee, pluck it out." Acting upon this precept they dug out the old sand, cast it aside, and put in new material which had to hauled from a distance of several miles at considerable expense. At that time no one, apparently, realized that the dirty sand could have been washed and replaced at low cost. But the climax to the comedy occurred when someone suggested that the cost of hauling new sand could be reduced by dumping the material into the intake and allowing the water to carry it to the filters—through 35,000 ft. of pipe, including several inverted siphons. This plan was actually put into effect, but the committee is still waiting for the sand to make its appearance at the filters. No better example of misdirected zeal could be cited, for these councilmen were probably sincere in the belief that they were saving the city money by directing the work at the filters. When engineering societies have had more time to spread the doctrine of sound technical advice in sanitary engineering matters, instances of this sort will be more infrequent.

Progress in Vocational Training

GRATIFYING indeed is the biennial report of the Wisconsin State Board of Industrial Education, bringing the record for this work to the end of June, 1914. As those interested in the development of the continuation and the vocational school in this country know, the Wisconsin Legislature in 1911 provided for aid to cities which maintain vocational schools. The appropriation for the first year was $35,000, increased successively to $50,000 and then to $150,000. As was to be expected, response from both cities and manufacturers was not enthusiastic at first, but due to the hard work of the board and the devotion of its members 12,219 students were enrolled during the year ended June 30, 1913. That progress, indeed, was gratifying but was only a promise of still greater expansion, for in the year ended June 30, 1914, the total enrollment was 25,453. In this work the cities and State together expended about $380,000, of which amount the State contributed about $94,000, leaving part of its appropriation unexpended. Of the enrollment given above, 5500 and 10,000 respectively represent children taking work during the day on time for which they are paid by their employers, in other words, are continuation school pupils as the term is generally understood. The others are in the full-pay or evening vocational classes.

The success of the movement in Wisconsin has been due to the co-operation secured between school boards and local manufacturers. The difficulties first experienced have been brushed aside by a full understanding on the part of the former of the real requirements of vocational education, and, on the part of the latter, of the benefits to be derived by their employees, and, indirectly, by themselves. The list of industries in which co-operation is now effective is too long to be printed here, but it can be said in general that provision for instruction along a specialized line is provided in cities of 5000 population and over for every occupation in which any considerable number of boys and girls are engaged.

In the past we have had to look to Germany for models of hope-giving and opportunity-making continuation schools. Now, fortunately, we can point to an accomplishment at home that may be an inspiration for our efforts along the same lines. The seed which has grown so well in Wisconsin has been planted in other States and a rapid and effective spread of the continuation-school idea is to be expected. Several of the Eastern States have made provision for vocational education, New York City is trying the plan on a scale as elaborate as is desirable as a start, and Middle Western States have either made provision for schools of a similar nature or are contemplating legislation. While the form adopted in other States is not always identical with that of Wisconsin, the general theory is the same, of providing vocational education for those obliged to leave school at an early date and heretofore doomed to the narrow outlook consequent upon machine-like work in a highly-divided industry and to the discouraging prospects inevitably bound up with inefficiency.

Is the Contractor a Gambler?

EXAGGERATIONS are expected in the popular magazines, but when a periodical runs a financial section, planned to help its readers invest their money safely, one wonders how the story, "Six Tremendous Gamblers—and the Risks they Run," got by the editors of McClure's Magazine. The article appears in the May number and purports to be "a story of American business."

Absurdities sometimes are harmless. This one will act as a deterrent to legitimate investment, particularly in contracting enterprises—the phase of the article in which this journal is especially interested. One of the "six gamblers" is a contractor—a typical contractor, one would be led to believe. The story says that "he gambles all the time on the appalling forces of the universe, and he bets that his work will stand against terrific winds and floods and pressures of earth. He bets that he will be free from ruinous law suits. He plays a Monte Carlo game every day." How some of the large construction firms which sell their stocks to the investing public will relish these statements can well be imagined, and the dangerous feature is that the ideas are given publicity through a medium that can do much harm. The reader of the popular magazine is unable to judge of the correctness of the picture presented to him and is inclined to trust in the author.

These statements would not have been wrong, perhaps, had they been published twenty years ago, but they are very far wrong as applied to the contracting business to-day. With the formation of large corporations, the element of chance has been largely reduced, at least insofar as work of any magnitude is concerned. Large firms can afford to engage experienced men, capable of estimating probable difficulties and of devising adequate safeguards. Moreover competent experts are retained on technical features and elaborate cost-keeping systems eliminate guess-work as far as possible in the determination of unit prices. The seasons, of course, cannot be controlled and rivers will often rise, endangering cofferdams and partly finished work. But the old-time thrill is gone, for such contingencies are foreseen, the minimum of damage results and the costs are provided for in the estimate. Ruinous law-suits are no longer bet against; they are insured against, by avoiding the causes that give rise to them and by carrying liability insurance to provide against injury to workmen and to the public.

Undoubtedly some contractors of the stripe depicted still exist. They are the exceptions, however, and not the rule, and their number grows less every year.

More About Annual and Other Reports

IT is common knowledge that in an architectural competition to be judged by laymen an attractive, easily understood picture usually wins over a plain, uninteresting drawing, despite the fact that the latter may present much the better design. Engineering works frequently do not lend themselves to pictures made by either pencil or camera. Consequently, word pictures become the more important. Whether describing work done or to be done, whether annual or special, that report will be most successful in winning approval which first arrests attention, then holds interest by a sequential, live and logical development of the subject, and finally leaves in the reader's mind a clean-cut, comprehensive idea of the project, with the most important elements standing out in relief, in proper relationship.

Successful report writing demands an imagination which can work from the viewpoints of the probable readers, and which, therefore, can perceive the features which will interest them, and conceive ways for putting life into the "deadly uninteresting." To this end a rich vocabulary, precise diction, intelligent discrimination in the use of words, and skill in arrangement of chapters, paragraphs and sentences, all contribute. Native deficiencies in these directions can largely be made up by painstaking work. Too frequently unimportant ideas or words are carelessly allowed to fall into prominent positions. Involved and incoherent sentences and tedious sameness of expression destroy interest. Poor English is an unfit vehicle for presenting good engineering.

Illustrations have much to do with the success of some reports. If photographs, they should be good pictures as well as making plain the subject to be brought to the readers' attention. Titles, while concise, should be sufficiently complete to bring out the full value of the picture. In some cases explanatory matter beneath the title is desirable. These suggestions will apply also to maps and other drawings. In drawings common faults are overcrowding—seeking to show so much detail that after reduction clearness is lost—lack of relief by failure to use lines of different weights to give prominence to the main features and subordinate the minor, and lettering so small that after reduction it is illegible, or, at best, discouraging to most eyes. Each illustration, if practicable, should be placed near the text to which it is related.

Typography, also, is important. A clean, easily read text often may be displayed to advantage by suitably balanced chapter, page and paragraph headings. Such headings, if skilfully used, are valuable aids in catching attention and in finding information sought. Titles of tables should be complete and accurate, and column headings, while brief and even abbreviated, should not leave the reader in doubt.

But annual reports are not written and printed solely for the outsider. Not infrequently they are the most surely permanent record and the most convenient reference book for use in the further conduct of the work. These uses should be kept in mind in their preparation, but the annual report should not be burdened with matter which rightfully belongs in a manual of instructions for employees. Details, too, belong in appendices, not in the main report, while tabular matter relating to routine matters should remain in the record books of the department.

Primary facts are all too commonly left unstated. A report writer having progressed far into the details of the work sometimes loses his perspective and forgets that information which long ago became part of the subconscious groundwork of all his thinking has not yet been imparted to his reader, yet is fundamental to a correct understanding of the more detailed statements.

Once in a while a report has to be searched for its date, which ought to be in a conspicuous place, and occasionally the outside of the bound book does not display conveniently the name of the community or department. A serial number placed on the back is often useful for reference. A distinctive, pleasing color for the cover is worthy of consideration. More frequent use of good colors would break the monotony of dull, funereal black which dominates some libraries of engineering books. Enough has been written in the past about standard size to warrant silence here on that detail of the subject.

Some of the suggestions which are pertinent for a large city or department do not, of course, fit a small town, but in any case a report should be suitable for its purpose and its readers, and should do justice to the work to which it relates. If the purpose be clearly borne in mind and precedent disregarded the improvement would be immediate. Such improvement is earnestly to be desired to the end that the public at large may be more interested than in the past in the works for which it is called upon to pay.

The Jitney—Its Wane and Possible Influence on Urban Transportation

REPORTS from Los Angeles, the city where the jitney-bus began its astonishing career, show a steadily decreasing number of machines in jitney service and indicate the beginning of the end of this extraordinary experiment in urban transportation. Its life was bound to be short, for, fundamentally, its economics were unsound. The term "jitney-bus" is here applied only to the 5-cent lines, using second-hand pleasure cars, and not to the formally established auto-bus lines, equipped with a number of large, specially designed units, and generally charging a ten-cent fare.

The jitney fallacy has been based on two erroneous major assumptions. In the first place, the average daily receipts have been greatly exaggerated, being frequently reported as $10 a day, although as a matter of fact it is seldom that they exceed two-thirds of that sum. This result has been demonstrated by individual observations and even by dividing the total number of passengers carried on a certain day (as reported by the jitney bus associations themselves) by the number of cars reported in service on that day.

The second false assumption of the jitney operator is that his expenses for gasoline, oil, tires and repairs are the only ones involved in the business. These amount to between $3 and $4 per day, so that the bus shows an apparent profit equal to a living wage for the driver. Unfortunately, the less visible charges for interest, depreciation, accident damages, license fees, and the like, cut the drivers' actual wages down to zero, or so close to it that eventually he drops out, only to be replaced by someone, who has not already obtained the experience.

Just this condition has been found to obtain in Los Angeles, where the jitney drivers stick at the losing enterprise only for an average period of sixty days. Until recently, however, the newcomers entered the business in sufficient numbers to maintain the total, but at present this is considerably below the maximum that was established during the winter. As a decrease has been found also in San Francisco and as in neither city has any legal restriction of any kind been placed upon jitney operation, the early end of the movement as a whole, even from purely natural causes, seems to be inevitable in the near future.

However, if the length of haul is sufficiently short it is possible to transport passengers profitably at a 5-cent fare even with a horse and wagon, so that the jitney-bus, inefficient as it is, may thrive permanently on runs between points which are, say, only 1 mile apart and between which the traffic is very heavy and fairly well maintained throughout the day. Two other conditions are essential also to the jitney's success, namely, that some of the traffic shall be handled by a street railway on the same route which will take care of the irregularities in the supply of passengers and thus permit the jitneys to obtain reasonably full loads at each trip; and that the number of jitneys shall not be so great as to reduce each others' average load per trip. As the traffic conditions thus outlined exist today in several American cities, and as the number of jitney-buses that may operate on any run is only limited by the minimum wage at which a jitney driver will work, it is safe to say that, without restrictive legislation, the jitney will become a permanent fixture in some few communities.

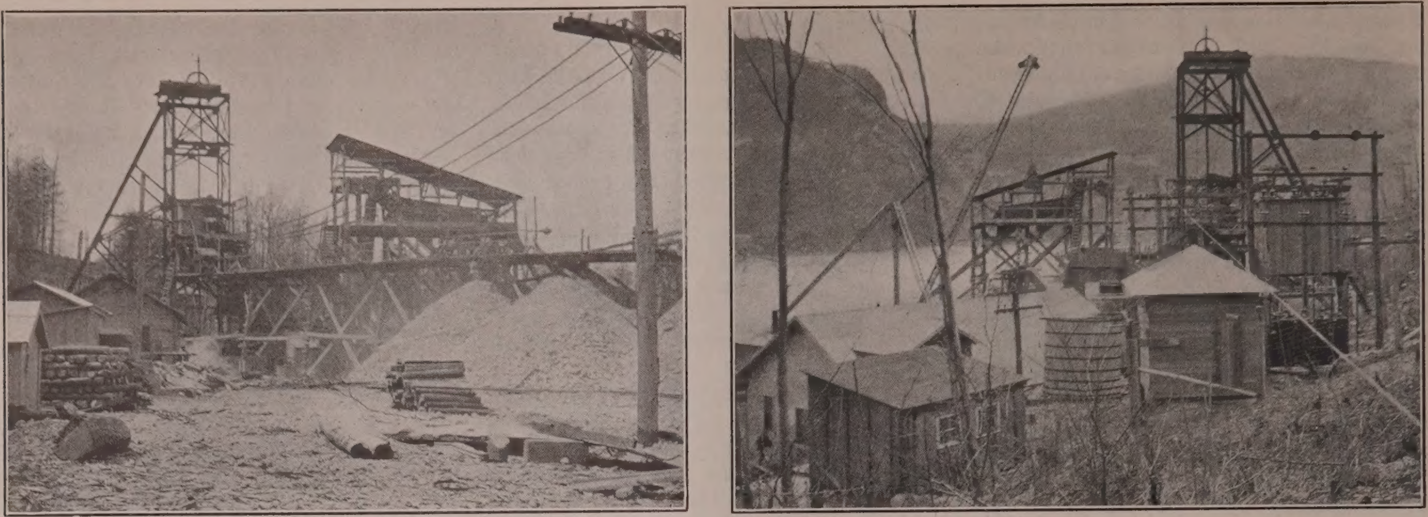
This prophecy, however, does not cover the possibility of the abolition of the flat 5-cent fare that is a universal characteristic at present in American cities. The electric railway car is, inherently, a more efficient means of transportation than the jitney-bus, and on runs where the jitney can survive on a 5-cent fare the electric car will make big profits at 2 cents, provided it can charge in proportion for the longer runs. If, therefore, the strained relations between the two should break out into the open warfare of direct competition, the first result will be the establishment of the zone system of fares. This is a revolutionary step for any American city, for it means inevitably the starving of the suburbs. The alternative may well be considered seriously.

Such a drastic means of reprisal, however, is not likely to be put into effect. It has been found that the jitney cannot survive, under any circumstances, legislation that demands from it responsibility and taxes equivalent to those imposed on the street railways, and as the introduction of the new means of transportation has, itself, helped to educate the public in these matters, regulation is practically certain to be imposed eventually by every city where the jitney persists.

At the same time, perhaps, the jitney may have helped to educate the street railways of the country along lines that have been decidedly neglected in the past. It has shown beyond a doubt that the public wants speed, even above all considerations of physical comfort. Five-passenger cars carrying ten or twelve people have been common sights in the Western cities, but these grossly over-crowded vehicles have traveled at speeds of 12 or 14 miles per hour and thereby have satisfied their patrons.

Some part of such a fast schedule may perhaps be due to a higher maximum speed and therein it involves an element of additional danger. But on the other hand, it is certain that the small capacity of the jitney has enabled it to make fewer stops than the street car, which, in ordinary city service, may spend less than two-thirds of its time in real free running. Apparently the influence of the size of unit has been completely neglected heretofore, some railways having even taken up two-car trains without compensating for the time lost in the additional stops that they involve. Then too, the skip-stop plan, wherein stops are made only at alternate cross streets, is in use today in so few cities that practically no data are available as to its economies. Express service for urban operation, under which non-stop cars for outlying districts are started out just ahead of local cars, is absolutely unknown, as well as other plans for increasing schedule speed, notwithstanding the fact that the railways as well as the public would benefit by faster schedules.

The advent of the jitney will, perhaps, change this ultra-conservative attitude of the traction companies. Certainly if it does so the jitney will have accomplished an end that will be worth all that it has filched from railways in its raid upon their short-haul traffic—the only profitable business that they have under the flat 5-cent fare.



OPPOSITE SIDES OF SHAFT 7—LEFT, BLACKSMITH SHOP, HEADFRAME, DUMP TRACKS AND CRUSHER PLANT—RIGHT, COMPRESSOR HOUSE BELOW DERRICK, AND TRANSFORMER HOUSE

New Tunnel, 400 Feet Below Existing Bore, Replaces Short Section of Damaged Catskill Siphon

Time Limit Requires Rapid Construction at Moodna Siphon in Spite of Fact That One 8-Foot Shaft 400 Feet Deep Is Only Means of Access to Work

WHEN CRACKS developed in a short stretch of the concrete lining at the easterly end of the deep Moodna pressure tunnel of the Catskill aqueduct at Cornwall, N. Y., following a hydrostatic test during which the water pressure caused a very slight movement of the gneiss backing, the Board of Water Supply of New York City decided to replace the damaged section by a new tunnel, parallel to the original one and 400 ft. beneath it. This work, involving the unusual feature of sinking a deep shaft from a point within the original tunnel 420 ft. underground and the driving of a bore 900 ft. long, to form a new connection between the Moodna siphon and the west shaft of the siphon, which will carry the flow of the aqueduct underneath the Hudson River, is being done against time by the Oscar Daniels Company. The shaft sinking record for the Catskill aqueduct has had a close call, and some rapid tunnel driving is in progress, in spite of the fact that both the tunneling and sinking are being carried on of necessity through one 8-ft. diameter shaft, up and down which three shifts of fifty men must pass each 24 hours, in addition to the muck from a 6-ft. shaft shot.

As it was necessary that work should begin as soon as possible after the weakness developed, to make sure of the commissioning of the aqueduct on time, plans were at once gotten out, and a contract awarded last November.

WORK OPENED IN WORST SEASON

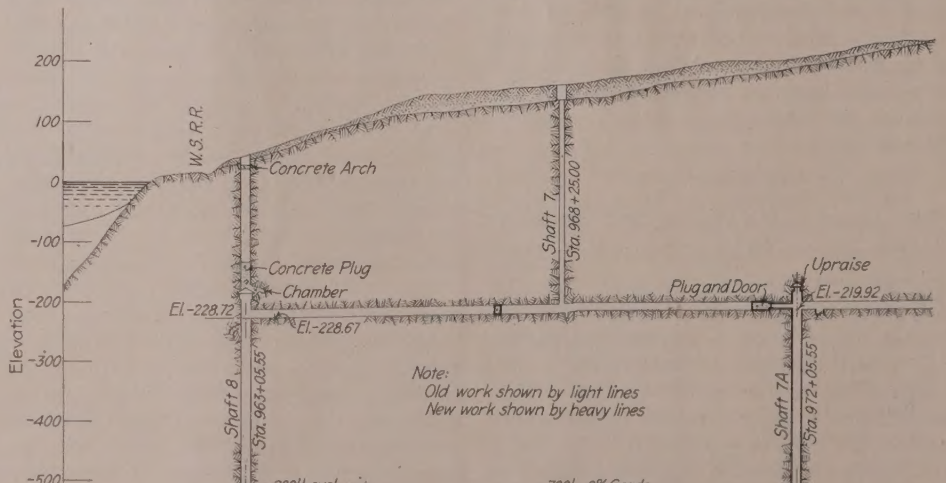
Among the feats accomplished and proposed by the contractor are setting up on the side of Storm King mountain in the dead of an up-State winter a 1000-hp plant—a very expensive one to be assembled around a single shaft—and the fitting of cage guides in old concrete-lined shafts 7 and 8, while menaced by slides from a thick and continually forming inside ice skin. A 30-ft. upraise over the new shaft had to be cut out, and an I-beam and timber platform suspended 800 ft. below the river in shaft 8, from which to start the east heading of the new tunnel. Wet concrete for lining the new shaft is being dropped vertically 400 ft. down a 10-in. pipe with success, and concrete for the tunnel lining will be so dropped for 800 ft.—both unprecedented distances.

In spite of troubles with placing concrete footings in zero weather, and drilling the 50 ft. plug above the old tunnel level in shaft 8, the contractor has in the first four months set up his plant and accomplished over 30 per cent of the permanent work to be done. The prompt completion of the contract seems now assured.

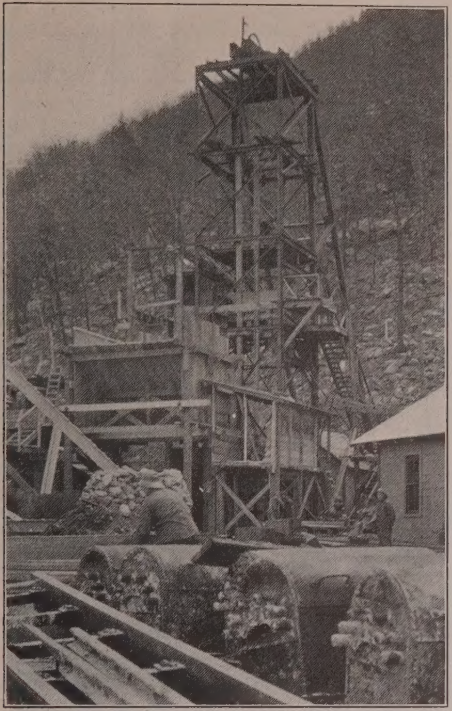
CONDITIONS BARRED ACCESS TO THE WORK

A glance at the profile of the old and new tunnels shows that access to the new work without the delay of sinking a new shaft from the surface could be had only through old shafts 7 and 8. Of these, shaft 7 had been finished as a permanent access shaft with an inside diameter of 8 ft., which would accommodate but one hoistway. Shaft 8 was closed at the top by a concrete dome and was also sealed 30 ft. above the old tunnel with a concrete plug 50 ft. thick. Possibly as an effect of the failure referred to during the test of the tunnel, the leakage in shaft 8 above this plug had increased from 5 to 70 gal. per minute. Already 150 gal. per minute, coming from several miles of tunnel above the work and collecting behind a 6-ft. bulkhead in the tunnel west of the new shaft, had to be reckoned with, beside a slightly greater quantity coming through the Hudson siphon from a section of tunnel east of the river. To cut out this plug, which might involve breaking the shaft lining, held dangerous possibilities, and the idea of hoisting muck to the surface through shaft 8 was reluctantly abandoned.

Some time had been spent in cutting out the dome in shaft 8 and getting to the plug. When conditions were realized, a



NEW TUNNEL INCREASES LEAST ROCK COVER FROM 260 TO 420 FEET



CONCRETE PLANT AND HEADFRAME

core drill outfit was at once called in to cut two 8-in. holes through the plug. One of these accommodates the hoist cable from the surface, and the other will be used for chuting concrete.

PLANT ARRANGED IN CRAMPED QUARTERS

This left to the hoistway in shaft 7, midway between the new shaft and shaft 8, the entire work of taking out the 15,000 odd cubic yards of rock to be excavated, and handling the men, plant and materials needed below ground. Air and electric power also had to be carried down this shaft. Furthermore, a saving of time and money could be made by having a crusher plant on the job, and turning part of the excavated rock into concrete materials.

Therefore around shaft 7, partly on the small spoil bank left from previous construction, and partly on the mountainside, a quantity of equipment is grouped, which required careful layout to prevent congestion.

A transformer station, taking 3-phase, 60 cycle alternating current at 33,000 volts from the transmission line, steps it down to 2200 and 440 volts for the compressor plant. In this plant are located a pair of two stage compressors, one a 1250 ft. and the other a 900 ft. machine, and a generator supplying direct current at 110 volts for the lighting system. The voltage is further reduced to 220 volts for the rest of the construction plant. On the hill side of the shaft is the hoist house, opposite which is a ¾-yd. mixer with its charging bins. One dump track at ground level and one on a trestle, placed at slight angles with each other, lead toward the river and directly away from the compressor house. On the uphill side of these tracks, below the hoist house, is the blacksmith shop, and on the other side the crusher plant. The two McCulley crushers, one No. 5 and one No. 3, and the sand crusher and screens in this plant, are all driven by belt from a jack-shaft with a 100-hp motor. The blacksmith shop runs three shifts, and could not keep up without a pneumatic drill-sharpener. The crusher plant takes stone from the trestle, and delivers its material to two storage piles over the side of the old spoil bank. A steel clamshell derrick, run with a steam hoist—the only steam plant on the job—feeds this material to the mixer. This derrick will also load cars, which will run down hill to a second mixing plant to be set up at shaft 8.

The two surface hoists (one at shaft 8), and one located underground at the new shaft, are single-drum 115 hp electric mine hoists with a rope speed of 300 ft. per minute. The muck cars are solid body, hold 1 cubic yard, place measurement, and are dumped in tipples.

ARRANGEMENTS BELOW GROUND

Two storage battery locomotives, one on each side of shaft 7, handle cars from shaft 8 and from the new shaft on a double-track narrow-gage line in the old tunnel. A third locomotive will be used in the east heading of the new tunnel as soon as excavation has gone a little farther. Muck from the new shaft is hoisted into the upraise in round turn-over buckets, dumped into a small hopper and drawn from there to the muck cars. Rock from the lower tunnel is loaded direct into these cars, which are raised to the old tunnel floor on a standard cage handled by the surface hoist at shaft 8.

Concrete for the new shaft is being spouted from the surface into the round muck buckets, which are hauled to the new shaft on platform cars and lowered to the forms.

DRILLING OPERATIONS

After March 1, when the sinking in the new shaft was fairly started, more than 6 ft. a day was averaged for some time. Bull Moose drills were used, one shift drilling and shooting and two shifts mucking. When it is remembered that this muck had to get out through shaft 7 at the same time with rock from the tunnel heading, where as much as 10 ft. a day was being made, and that the same shaft had to stop three times a day to change crews for both shaft and tunnel, this record is remarkable. The rate of progress, 6.125 ft. a day, equals that of the shaft sinking record for the entire aqueduct. When this shaft had reached a point 302 ft. below the upper tunnel floor, "popping" rock was encountered, and it was found necessary to stop sinking and place the concrete lining. This "popping" rock, which has caused some trouble also in the tunnel, is said to be due to enormous internal stresses in the gneiss formation, probably caused by lateral compression. Pieces of rock, often of some size, will crack off suddenly from a sound face and fall, endangering the lives of workmen below. In addition to rapid progress, the shaft was cut with unusual accuracy. A slightly less volume of rock was actually taken out than is included within the payment circle, though almost every section measured showed outside the clearance circle without trimming.

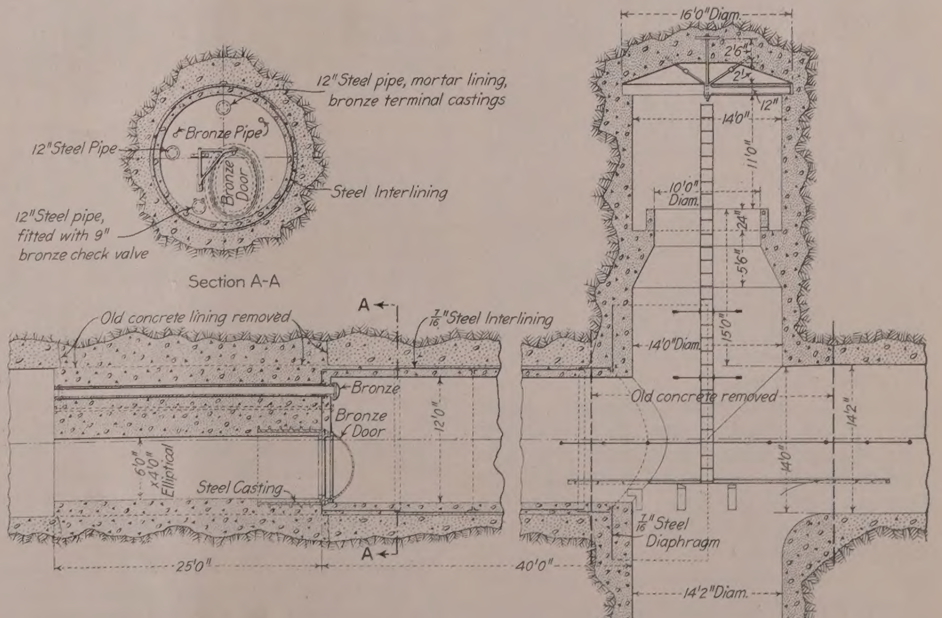
In the tunnel four water-Leyner drills on two columns are used at the heading, and two of the same drills mounted on tripods take out the bench. Two shots of 5 ft. each in both bench and heading are now being made and mucked every day. The heading on March 30 had progressed 385 ft. from shaft 8.

WATER PROBLEMS

Two electrically-driven Simplex pumps, each able to deliver 300 gal. per minute against the 400-ft. head to the top of shaft 7, are located at the bulkhead west of the new shaft to handle the water coming down the tunnel. The water from the other side is now being pumped at the permanent station on the east side of the Hudson, but pumps similar to those in the upper tunnel will soon be installed in the new heading near shaft 8 to lift this water to the pumps on the upper level.

PROGRESS AND ORGANIZATION

The job involves, roughly, half a million dollars. For tunnel work, the 900 hp used continuously and the 220 men employed are in excess of the average on a contract of this size. Good organization and constant and able attention are called for to apply this excess in power and working force to increase the progress of the work. S. A. Knowles, the contractor's superintendent, is a busy man, and the work also has his



FINISHED CONSTRUCTION WHERE NEW SHAFT LEAVES OLD TUNNEL

Watertight steel interlining and concrete plug block flow of water in old tunnel east of new shaft close and at times the undivided attention of D. E. Baxter and C. L. Ostenfeldt, engineers of the Oscar Daniels Company. The engineers of the Board of Water Supply, by co-operation and by supplying a large field force to facilitate inspection and instrument work, are doing everything in their power to hasten the completion of the supplementary tunnel. Geo. J. F. Carey is field engineer on the work, and W. B. Hoke section engineer. Ralph N. Wheeler, department engineer of the northern aqueduct department, is in general charge for the Board of Water Supply, under Alfred D. Flinn, deputy chief engineer, and J. Waldo Smith, chief engineer of the board.

Wanted—Reliable Cost Data

WHEN an engineer is requested to point out wherein the paper of his profession can be improved, he is most likely to say: "You ought to publish more costs." Whereupon the editor smiles a weary smile, not of disdain but of ineffable sadness. The foregoing is taken from the Electric Railway Journal. The comments that follow are so pertinent to the civil engineering profession and civil engineering journalism that they are reproduced practically in full.

It is a fact that nothing is more keenly sought by technical papers than costs first, costs second and costs last. But few engineers are willing to make public this information in detail, and still fewer executives will sanction such a course by a broad-minded subordinate.

A stock objection raised by the operator, when costs are requested, is that such figures would be of no use as a guide to others. And then our old bugaboo, "local conditions," is trotted forth with all the impressiveness of the stuffed lion in a Christmas pantomime. Of course, it is not pretended that figures are everything. In fact, figures offer only a starting point; but a starting point we must have.

The objection to giving out costs has lost much of its force in view of the detailed accounting data that must now be filed with public utility commissions. Many of these data are available to anyone who cares to copy them; but unless the corporation is willing to aid in their interpretation, the most misleading conclusions may be drawn, for in the broadest sense the word "costs" must be understood to include an explanation of accounting practices and engineering standards.

Apropos of misinterpreted figures, a certain engineer protested quite vehemently at a published comparison with his costs as taken from a government publication. Yet a few months before the same engineer refused to permit the publication of a descriptive article, with costs, that would have placed the practices of his company in a more desirable light.

In short, engineers and executives should give up the idea that they lay themselves open to attack when they permit costs to be published. The unmistakable trend of the times is toward publicity; and as with liberty, the evils of publicity are curable by still more publicity.

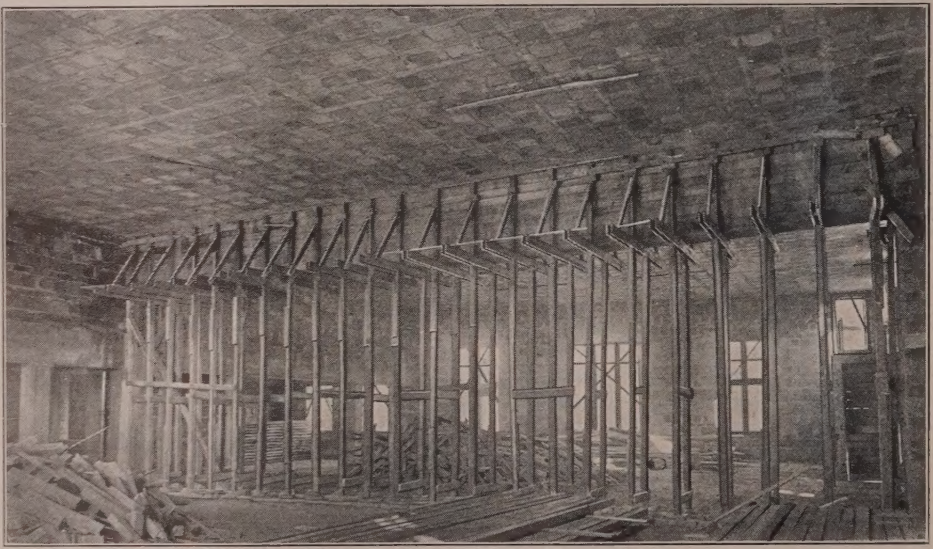
THE GATUN SPILLWAY was put to use April 3, owing to a heavy rainfall on the Chagres River watershed. Five gates were open part of the time, effecting a maximum discharge of 64,015 sec.-ft.

Long-Span Roof Slab of Concrete and Tile

Concrete Top Surface, Large Hollow Tile, and Two-Way Reinforcement Used to Span 49 x 46-Foot Rectangular Opening

By MAX MILLER
Civil Engineer, Public Service Commission, First District, New York

THE principal engineering feature of the Odd Fellows Building at Manchester, Conn., erected during the summer of 1912, is a flat-roof construction covering about one-half of the structure. The building is about 92 x 100 ft. in plan. Part of the basement is used for bowling alleys, the remainder for mechanical equipment and storerooms. The entire first story is partitioned into stores. The second and third stories in the higher half of the building are used for office purposes.



UNDER SIDE OF ROOF SLAB—BEAM CENTERING STILL IN PLACE

In the two-story half of the building the second or top story is used as a lodge and banquet room, is trapezoidal in plan and measures approximately 49 ft. wide by 81 to 92 ft. long. The architects required this area to be free of columns and to have a flat ceiling, but permitted the projection of a beam over the sliding doors which divide the lodge room from the banquet room.

GENERAL DIMENSIONS

A beam was therefore located on a line dividing the roof area into two panels, one rectangular, 49 x 46 ft., and the other trapezoidal, 49 ft. wide by 35 to 46 ft. long, approximately. These two panels were spanned by two-way reinforced-concrete and tile slabs constructed of 12 x 12 x 12-in. hollow tile, spaced 4 in. apart on all sides, giving a system of channels which formed concrete ribs, 4 in. wide, spaced 16 in. on centers running in two normal directions. The open ends of the tile were closed by U-shaped sections made with fine wire mesh. The concrete slab was poured 6 in. thick above the top of the tile at the middle of the span and sloped to a thickness of 4 in. at the supports.

The concrete ribs were each reinforced by one 1¼-in. square bar, except those in the trapezoidal panel running parallel to the girder, which required two 1-in. square bars. To provide for negative moment over the supporting girder, 1¼-in. square bars 22 ft. long were located in the top of the slab, one over each rib, extending equally into both panels. A continuous stirrup of 5/16-in. diameter wire was used for shear reinforcement in each rib.

The accompanying photograph shows the under side of the roof slabs after the removal of the slab centering, with the beam forms still in place.

DESIGN OF GIRDER AND COLUMNS

In designing the girder, the amount of load tributary to it was determined by the coefficients $B^3/(B^3+L^3)$ and $L^3/(B^3+L^3)$; in which B and L are the sides of the panel. The bending moment produced by this load was increased by 15 per cent to provide for the larger loading in the region of the middle of the span. Seven of the nineteen reinforcing bars in the bottom of the girder were bent up to reinforce the web against diagonal tensile stresses. The position of the bend in these bars was determined in a manner similar to that used for finding the length of cover plates in plate girders. The roof slab was made solid for a distance of 18 in. from the face of the web of the girder to provide the necessary compressive resistance.

Because of the monolithic nature of the construction, the deflection of the girder causes bending stress in the supporting columns, which was combined with the direct compression in proportioning them. The bars near the outside face of the column were carried up to the top of the girder, and turned horizontally to splice with the negative reinforcement in the girder.

The column passing down in the interior of the building was held securely by the second floor slab against the horizontal thrust induced by its monolithic connection with the girder. The other column is an exterior wall column and only borders on the second floor slab. To take care of the outward thrust existing at its foot, three V-shaped ¾-in. round bars were hooked around the vertical column bars near the outer face, so that they extended radially about 10 ft. into the floor slab.

CONDITIONS FAVORED ADOPTION OF LONG-SPAN SLAB

Several conditions of framing peculiar to this building combined to favor the extremely long span adopted for the roof slab. Approximately three-fourths of the roof-slab load is transferred directly to the enclosing walls. These walls of course have ample strength, so that the dead weight of the slab, amounting to 160 lb. per square foot affects the slab itself but not its supports. The extra material required for the slab is more than offset in cost by the elimination of beams and the suspended ceiling, simpler and cheaper formwork, and lower total story height. In addition, this construction has the large safety margin possessed by structures in which the proportion of dead load to live load is large. In this instance, doubling the live load on the roof would only increase the stresses by about 15 per cent.

The usual assumptions for bending moments and usual allowable stresses were used in the design. The reinforcing steel, however, was all of high-elastic-limit grade and 18,000 lb. per square inch was permitted. The concrete was a standard 1:2:4 mixture. E. N. & R. E. Spaulding were the contractors and architects for the building. The writer designed the structural work under the general supervision of Carson G. French, of the Corrugated Bar Company, New York.

Two Time-Savers for Use with Influence Lines

Devices by Which the Position of Loading to Give Maximum Stress Can Be Found and the Desired Value Easily Computed

By D. B. STEINMAN, C. E., PH. D.
Special Assistant to Gustav Lindenthal, Consulting Engineer, New York

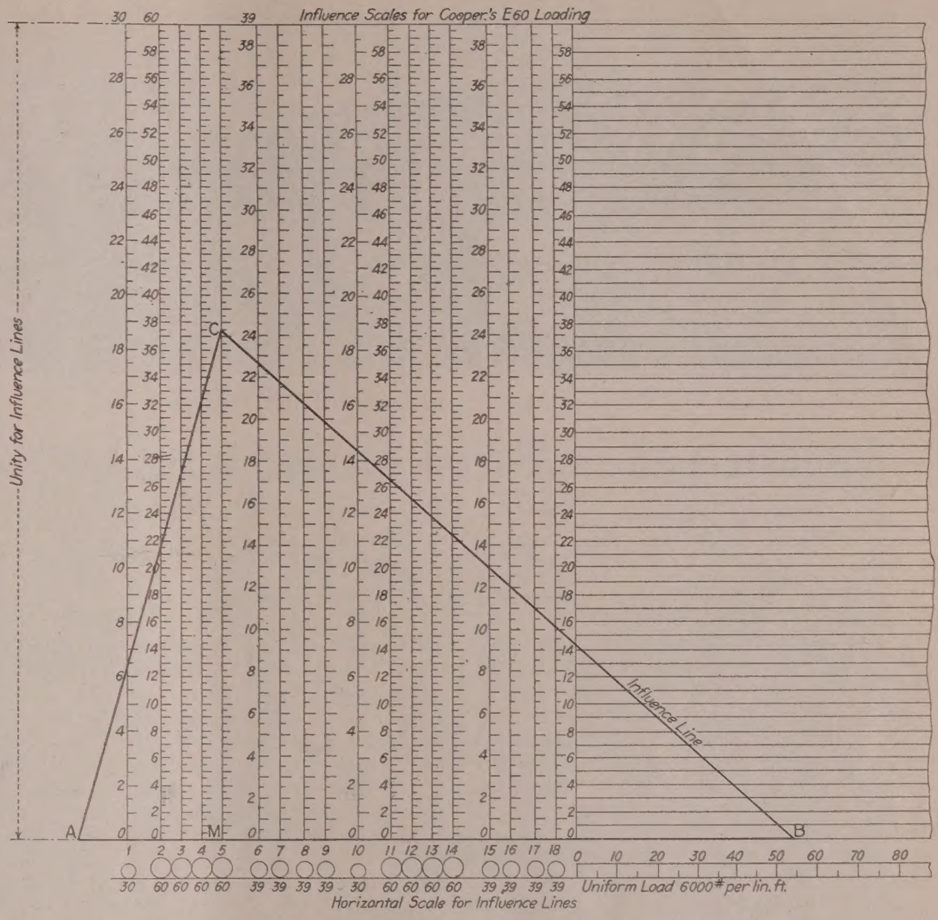


FIG. 2—DEVICE TO BE USED FOR SCALING INFLUENCE DIAGRAMS

THE ACCOMPANYING illustrations show two devices introduced by the writer to save time in the computations of some recent bridge projects.

The first device, Fig. 1, saves the time of trying different locomotive positions for maximum stress. It consists of a strip of tracing cloth on which two scales are marked. The first, or "Scale of Distances," is the ordinary wheel load diagram with the spacing of the wheels laid off to scale. On the other edge of the strip is marked the "Scale of Loads," in which the weights of the successive wheel loads are laid off continuously to any convenient scale. The scale of distances is first applied horizontally across the influence diagram ACB with an assumed wheel under the point C, in order to find the total load on the span or segment AB. In the illustration this amounts to all the wheels plus 54 ft. of uniform load. This scale must always be applied horizontally. The strip is then shifted and the scale of loads is slid upward until the same total load is intercepted (at DE) between the two sides of the influence triangle, the scale remaining parallel to the base of the triangle. The vertical CM will then cut the scale in the desired critical wheel, which is wheel 5 in Fig. 1. If the latter has been incorrectly assumed, a second trial should be made for a check.

If the base of the influence triangle is curved, as in indeterminate structures, place the scale of loads, DE, parallel to the chord of the curved base AB; if the base is sloping, place DE parallel to its slope. Minor inaccuracies of construction or manipulation will not affect the result. The device was found particularly useful in longer spans, beyond the range of the ordinary wheel load tables, and can be applied to any triangular portion of any influence line.

The theoretical basis of this device is the relation between the similar triangles CDN and CAM and the similar triangles CDE and CAB through their common altitudes CN and CM. This relation solves the well-known criterion for position of loads to give maximum stress, applying regardless of the scales used.

The second device, Fig. 2, saves the time of plotting the wheel positions and of multiplying the influence ordinates by the respective wheel loads. It consists of a tracing on which vertical lines are drawn through the wheels and graduated in scales proportional to the respective concentrations. The tracing is placed over the influence diagram, which must be drawn to the same scales as the tracing, with the previously-determined critical wheel under the vertex. The intercepts then give directly the products of ordinates by wheel loads, and their sum is the desired stress.

The writer acknowledges the prior invention of this useful device by O. H. Ammann, assistant chief engineer, New York Connecting R.R., who used it in 1906 in the computation of some cantilever bridge stresses. Both of these devices are easily constructed for any specified locomotive loading. With their combined use, the time and effort of working with influence lines are reduced to about one-fifth.

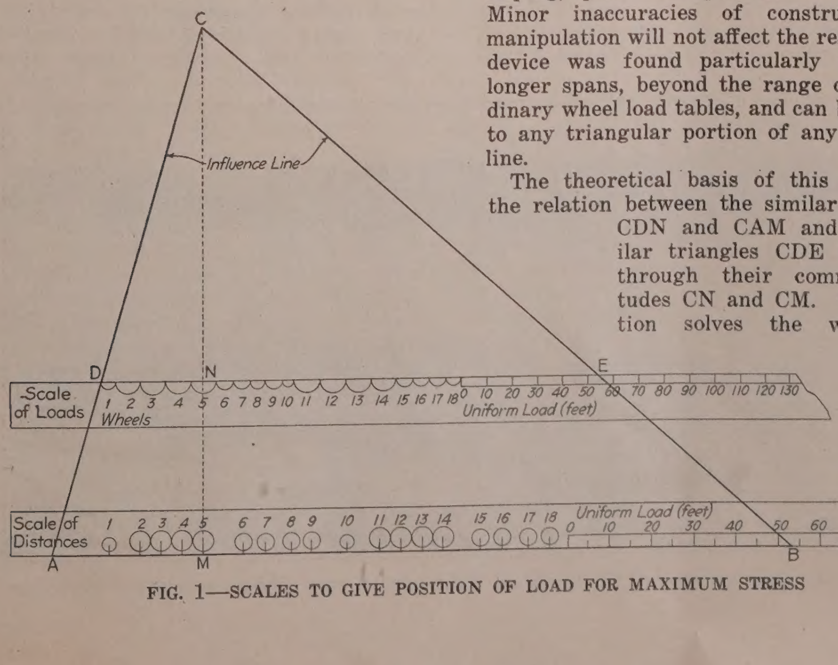
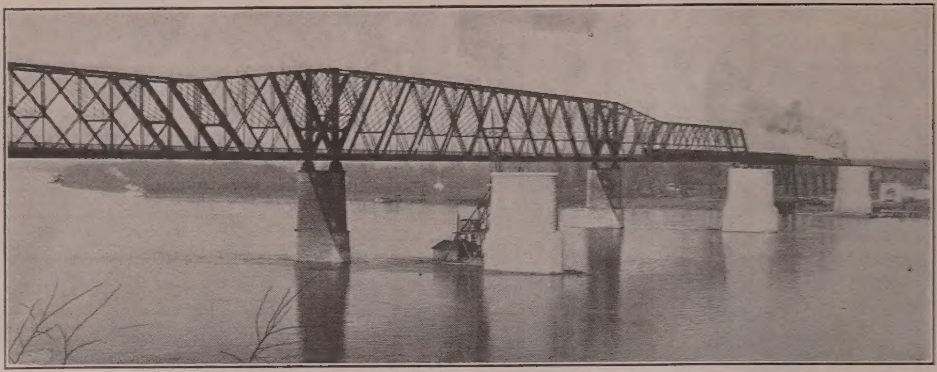


FIG. 1—SCALES TO GIVE POSITION OF LOAD FOR MAXIMUM STRESS

AN APPROPRIATION OF $1,355,520 was made by the last Congress for the work of the U. S. Geological Survey. In addition to this amount $40,000 was appropriated for rents, bringing the total up to $1,395,520. This appropriation is divided up in part as follows: Topographic surveys, $350,000; geologic surveys, $350,000; mineral resources of Alaska, $100,000; mineral resources of the United States, $75,000; chemical and physical researches, $40,000; geologic maps of the United States, $110,000; stream gaging, $150,000 and for surveying national forests, $75,000.



NEW PIERS AND EXISTING MEMPHIS BRIDGE FROM THE TENNESSEE SIDE

Substructure for New Memphis Bridge

Granite Piers Built on Pneumatic Caissons by Use of Construction Plants on Barges—Pile Dock and Willow Mat Aid in Placing Pier

By M. B. CASE

Resident Engineer for Ralph Modjeski, Consulting Engineer, Chicago

ALL TRAFFIC westward from Memphis must now pass over the Mississippi River on a single-track bridge completed in 1892 for the Kansas City & Memphis Railway & Bridge Company, which has since become a part of the Frisco system. A new bridge is now being built by the Rock Island, the Iron Mountain and the Cotton Belt systems through their joint organization styled the Arkansas & Memphis Railway Bridge & Terminal Company. Work was commenced in June, 1913, and the substructure was entirely completed in January of the present year, slightly more than eighteen months after the preliminary work was started at the site.

The present article will describe the plant and construction methods used in the completion of the substructure, including the piers and the pedestal foundations in the long approach. The manner of mixing and handling the materials on floating barges, the building of the pneumatic caissons in large removable pontoons, the use of shafts, air locks, compressor plant, etc., and the advantages of willow mats and pile docks for aid in preventing scour and placing piers all constitute features of this work which will be treated in some detail.

GENERAL DESCRIPTION AND DIMENSIONS

The bridge will carry two railroad tracks between the main trusses, which are spaced 34½ ft. on centers, and two roadways 14 ft. wide placed on brackets on the outside of the trusses. The main bridge is 2550 ft. in length from the anchorage pier on the Tennessee bluff to Pier 5 located 345 ft. back from the low bank on the Arkansas side. Beyond this point a tower-and-girder viaduct continues over the bottom land for a distance of 2363 ft. to the west abutment, where the tracks are carried on an earth embankment about 50 ft. high. The general features of this bridge were described in the Engineering Record of Nov. 8, 1913, page 516.

The center line of the new bridge is located 200 ft. upstream and parallel to the present existing structure, as shown in the accompanying photograph. Pier 1 on the Tennessee shore and Piers 2 and 3 in the river are directly above the corresponding piers of the old bridge, while Pier 4 on the Arkansas shore is located 17 ft. toward the river from the center line of the old pier, in order to make the span between Piers 3 and 4 a length which permits the duplication of the cantilever arms and suspended spans used between Piers 1 and 2.

The pneumatic caisson foundations for Piers 2 and 3 are 42 x 90 ft. in plan and 51 ft. in height; for Pier 1, 40 x 80 x 59 ft.; Pier 4, 31 x 77 x 62 ft., and Pier 5, 25 x 46 x 81 ft. All caissons rest on a very hard blue clay overlaid by several softer strata of clay having slightly variable characteristics. Above this is a bed of sand covered with the shifting alluvial silt of the Mississippi River. The height from the bottom of the foundation to the coping of Pier 2 is 192 ft., and of Pier 3, 195 ft.

STORAGE YARD AND BARGES

The most convenient ground available for the large storage and timber-framing yard necessary was on the Arkansas bottom land along the viaduct. This location furnished ample space at small expense and would permit of a quick and cheap delivery of material to the barges for transportation to the piers. The first preliminary construction consisted in building about 2 mi. of track from the old Rock Island Hopefield line to the west bank of the river, and connecting with two tracks extending onto a dock equipped with a derrick for transferring material on the river, as shown in the photograph of Pier 4 on the Arkansas shore.

The first three months were occupied almost entirely with the building of fifteen barges, a part of which carried the various rigs needed in the construction, and the rest were used as cargo boats. In addition to these barges constructed on the work, six more were purchased second-hand and several other barges and a small steamboat were chartered from time to time as required to keep all parts of the work going without delay. A screw-propeller tug and two launches completed the marine equipment. The rigs built on these barges consisted of an air-compressor plant, a concrete mixing and delivering plant, a pile driver, three derrick barges and two mat-weaving outfits.

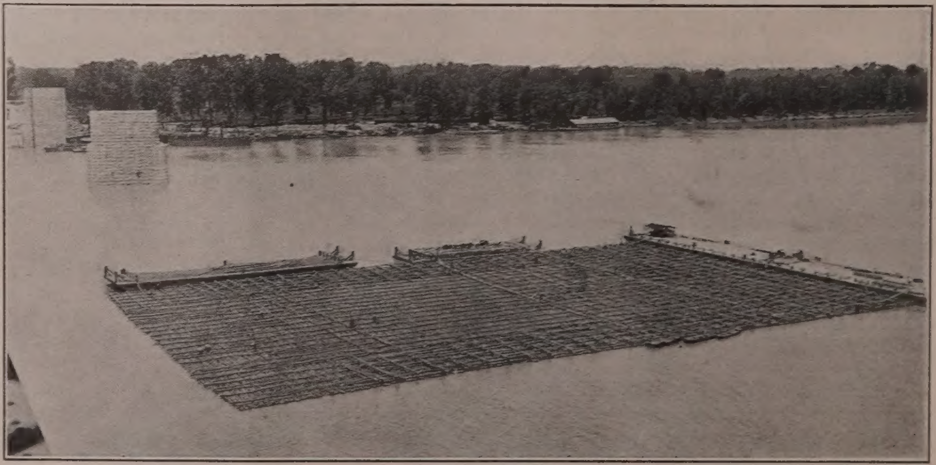
MIXING AND HANDLING CONCRETE

The concrete-mixing plant, equipped with the familiar tower and chute for the delivery of concrete, was built on a 36 x 100-ft. barge. Mississippi River washed sand and screened gravel were furnished by a local firm which operates a large plant a short distance below the bridge site. This material was handled on the bridge company's barges of 275-cu. yd. capacity each and raised into the hoppers over the mixer by a clamshell bucket and derrick, located on the opposite corner from the hoppers and the mixer. From these hoppers (sand 50-cu. yd., gravel 70-cu. yd. capacity) the material ran by gravity into a measuring hopper which discharged into a mixer of 1-cu. yd. capacity.

Cement was elevated in a measuring hopper in a small car pulled up an incline track by means of a line leading to a spool on the tower hoisting engine. The cement car ran back on a track extension under the roof of the cement barge, which was moored below the mixing plant, thus reducing the handling of the cement and the damage to sacks during wet weather. This barge carried a 60-hp locomotive-type boiler, furnishing steam to the mixer engine and tower hoist.

COMPRESSOR BARGE AND HOSPITAL LOCK

The compressor barge for the pneumatic caisson foundations carried four locomotive-type boilers with a combined capacity of 300 hp, and the necessary pumps and feed water heaters. Three low-pressure compressors with a capacity of 2500 cu. ft. free air per minute furnished air for the caissons, and one smaller machine furnished high-pressure air for the boring tools and hammers used on the timber construction. A 25-kw direct-connected generator furnished current for lights and for an elevator operated in the main shaft of the two deeper piers.



COMPLETED WILLOW MAT IN POSITION AT THE SITE OF PIER 2

The so-called hospital lock, for the use of the pressure men in relieving occasional cases of bends, or after-effects of the air pressure, by recompression, was located on this barge.

CAISSON BUILT IN PONTOON

Preliminary construction of barges and plant had advanced so that construction of the caisson for Pier 3 was started in September, 1913. This caisson was 42 x 90 ft. in plan and was built up 14 ft. in a pontoon before launching. The pontoon, 54 x 100 x 11 ft., contained a longitudinal joint to provide means of separating the two halves and withdrawing them from under the caisson after the pontoon had been flooded and the caisson floated. The weight of the caisson was distributed over the bottom of the pontoon by transverse beams, each of which consisted of two 12 x 12-in. timbers well keyed and bolted together to act as a single beam 24 in. deep. These beams rested on longitudinal 12 x 12-in. timbers of the pontoon and received the weight of the caisson at the cutting edge and center bulkhead.

The bolts in the longitudinal joint were removed just before flooding the pontoon, after which the submerged halves were pulled from under the caisson, the sliding surface being between the top of the longitudinal timbers on the pontoon and the underside of the transverse loading beams. The loading beams were then afterward pulled out by lines attached for that purpose before flooding the pontoon. The buoyancy of the pontoon was reduced very materially by loading with pig iron immediately before flooding. The launching of this caisson was accomplished without a hitch.

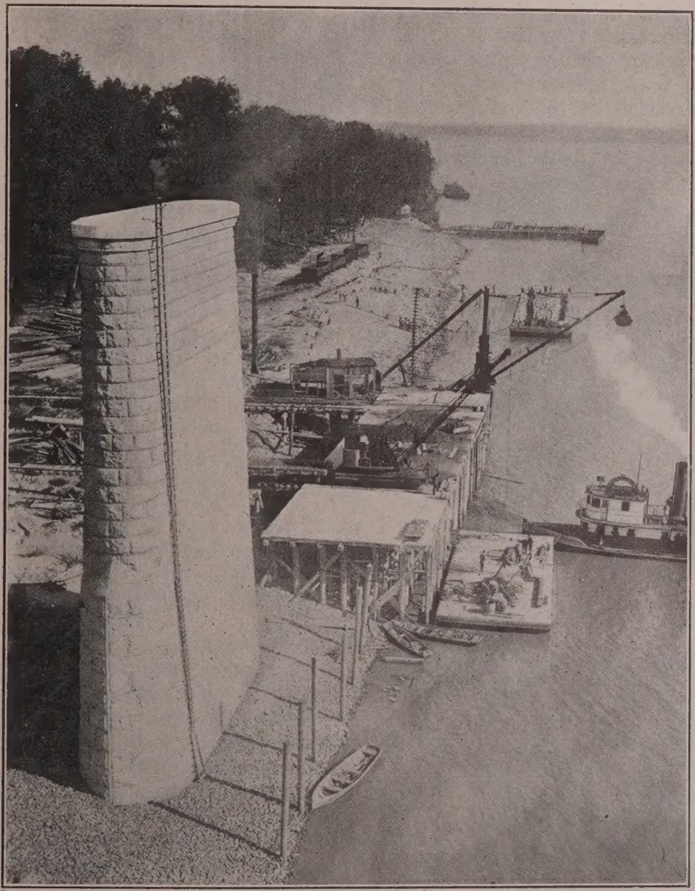
A well-braced pile dock had been driven around three sides of the pier site previous to the launching of the caisson. This dock proved very satisfactory for holding the caisson in position until well landed on the river bed, and afforded a convenient and economical staging for the caulkers and the work of planking the sides of the crib during the process of sinking. It also furnished a support for a derrick on the upstream end of the pier, thus getting a maximum amount of plant into position to work on the pier at one time.

SHAFTS AND AIR LOCKS

A 6-ft. shaft, with a lock at the bottom a short distance above the roof of the caisson was equipped with an electric elevator for handling the gangs in and out of the caisson, and in addition to this a 3-ft. shaft with a ladder and Morison lock was provided. Five 2-ft. material shafts were used for locking out the clay excavation and for passing in concrete when sealing the caisson. These material shafts were equipped with short vertical locks taking a bucket of 9-cu. ft. capacity handled by a derrick, the hoisting rope running through a packing gland in the top doors of the lock. These locks were very economical of air required for lockage.

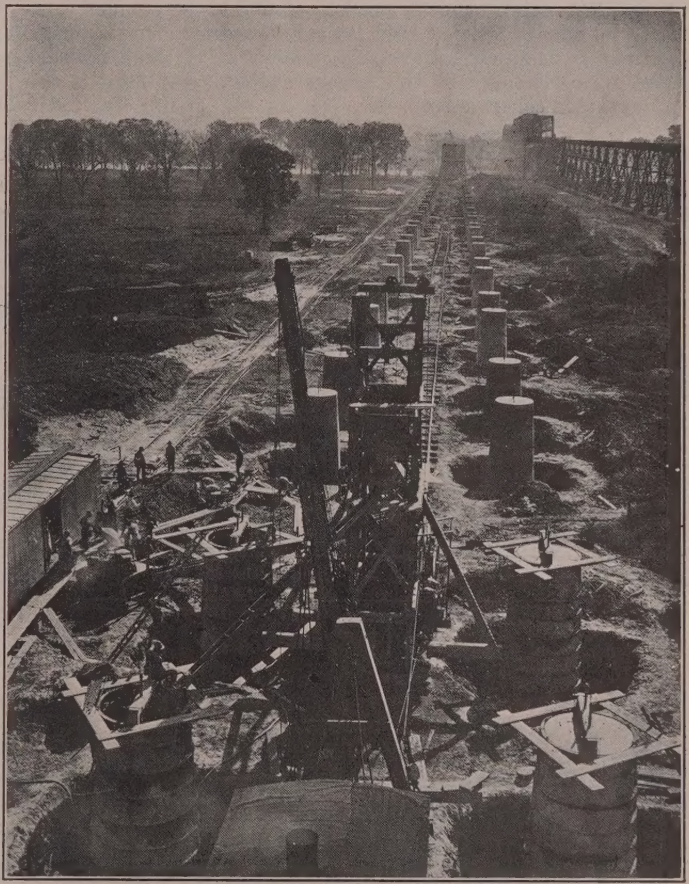
While the sinking was in sand which was handled through 4-in. blow pipes, the rate of sinking nearly always depended upon the progress of building up on top, but when the hard clay excavation was reached sinking usually depended on the rate at which the locks could remove the spoil from the working chamber. After the harder clay was reached the lower-strata progress depended upon the rate of excavating the clay ready to be locked out.

The material for the piers is a light gray granite from Stone Mountain, near Atlanta, Ga., backed with 1:2½:5 concrete up to the three courses under the coping, which are backed with granite. No difficulty was experienced in setting and backing one course each day. The water and sand were heated during chilly weather to hasten the setting action, so that the concrete was well hardened for the masons to work over on the following day. Flemish bond (header central over stretcher) was maintained with few exceptions and the courses were 3 ft. rise up to the starling, with thirty stones in each course. Above this point the courses reduce in thickness to a minimum of 2 ft. under the belting course.



PIER 4 AND STORAGE YARD ON ARKANSAS SHORE

Note shore protection work and derrick for transfer of material



PEDESTAL FOUNDATIONS FOR VIADUCT APPROACH

Looking east on Arkansas side—Pier 5 seen at end of approach

Because of the much deeper water at Pier 2 (50 ft. at Pier 2 and 30 ft. at Pier 3) it was necessary to use a removable cofferdam 15 ft. in height as an extension to the crib. This was done to permit the landing of the caisson on the river bed and to increase the buoyancy of the pier until sufficient friction and bearing was developed to carry the weight of the granite masonry. Because of the swifter current and consequent tendency to scour at this pier, the bed of the river was prepared to receive the caisson by sinking a willow-brush mat, 200 x 300 ft. in size, placed centrally over the site of the pier. The design and construction of this mat, which is shown in one of the photographs, differed in no way from those placed by the Mississippi River Commission on other parts of the river. After the dock was driven through the mat, 29,000 burlap sacks filled with sand were deposited at the pier site to reduce the depth of the water about 8 ft. and to give an even bearing on which to land the caisson.

Willow mats extending 150 ft. on each side of the bridge axis were afterwards sunk and covered with riprap for the entire distance between Piers 2 and 3 to protect the falsework from scour during the erection of the superstructure. After the completion of this channel mat work, the same plant was used to place a mat along the Arkansas bank, extending 1000 ft. above the bridge.

Pedestal Foundations for Viaduct

The seventy-six pedestal foundations and the west abutment were built during the summer of 1914. The pedestals each contain 53 cu. ft. of concrete and rest on a 13 x 13-ft. footing block supported by sixteen reinforced-concrete piles of octagonal section, 16 in. between faces at the top and tapering to 12 in. at the point, and 30 ft. long. The reinforcement consists of eight 7/16-in. square twisted bars, spiral wound with No. 4 iron wire at about 2½-in. pitch. The piles were cast on the Arkansas dock, using 1:2:4 concrete from the river mixing plant, removed to the storage yard by the locomotive crane after 48 hours, and cured thirty days or more before driving.

The concrete in the pedestals was made from crushed rock, delivered on cars, and was mixed by a plant rigged on a flat car with tower and spout delivery. This car ran down the center line of the viaduct, and the four pedestals of a tower could be poured from one position of the plant. The accompanying photograph shows the plant working on the last of the pedestals. The steel forms used for the pedestal shafts may be clearly seen.

Progress on Superstructure

Active preparation for the erection of the superstructure of the main bridge spans is now under way. Falsework is being placed under the anchor arm extending on to the Memphis bluff and derricks for unloading and storing the heavy truss members are being erected. The erection of the main spans and the viaduct approach will be under way during the coming season.

Ralph Modjeski, of Chicago, is the consulting engineer in charge of the design and construction of the bridge, and W. E. Angier is assistant chief engineer. The Union Bridge & Construction Company, of Kansas City, were the contractors for the entire substructure, including the channel mats and bank protection work. They were represented in Memphis by H. K. Seltzer, their vice-president and chief engineer, during the first season's work and later by J. F. Wilhelm as engineer of construction. The writer is resident engineer.

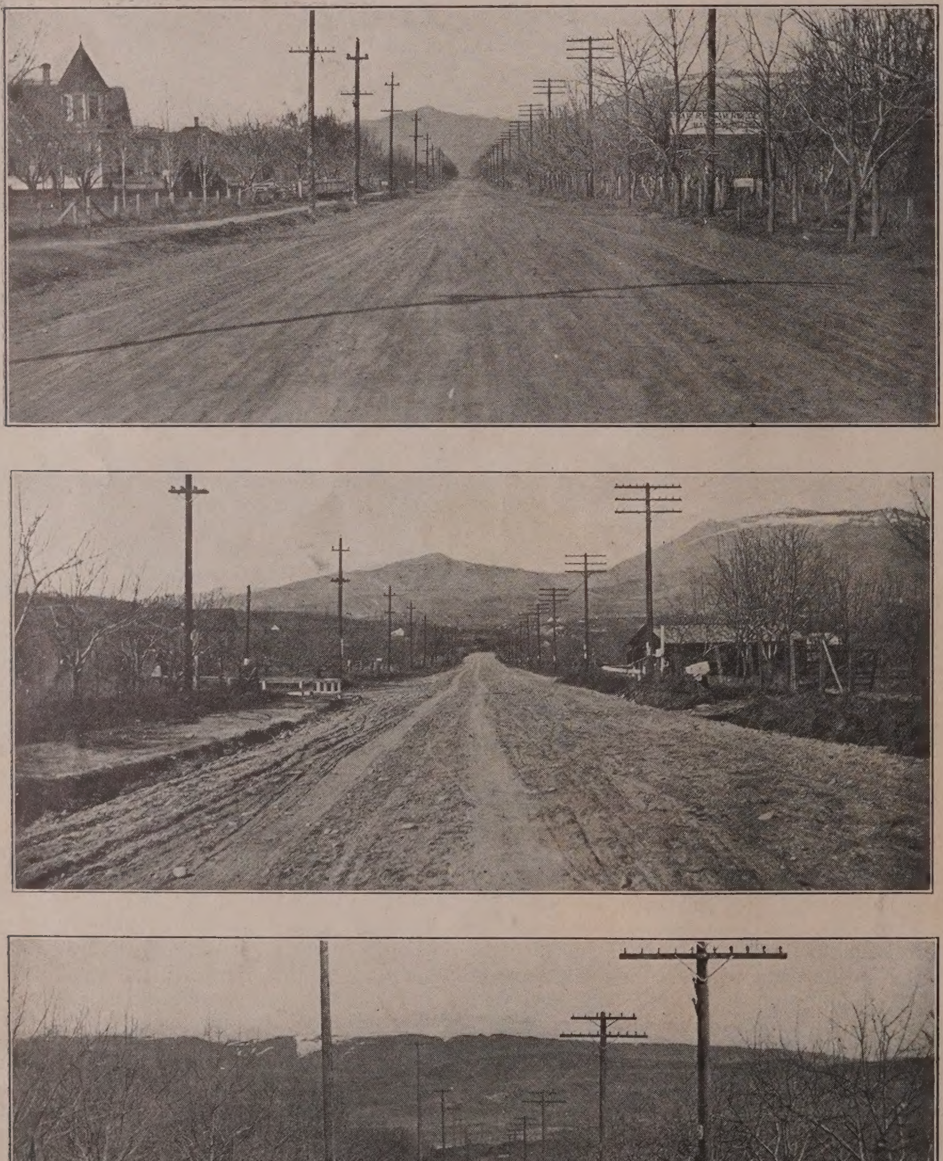
Motor Truck Reduces Sprinkling Cost 70 Per Cent

Earth and Gravel Roads in Chelan County, Washington, Watered at Expense of 30 Cents a Mile as Against $1 a Mile with Teams

THE MAINTENANCE of earth and gravel roads in a virgin country, whose soil is for the most part a light volcanic ash which cuts up into dust and ruts quickly in dry as well as wet weather, is a problem which appears to have been successfully handled in Chelan County, Washington. During the summer months the roads within a radius of 6 miles of each trade center have been sprinkled by common tank sprinklers. This has been done heretofore with horse-drawn 600 gal. tanks, with gravity filling stations, as near together as convenient, generally about ½ mile apart. Sprinkling which it is said kept the road in excellent condition even for heavy iron-bound wheel traffic cost $1 per mile per day. A road which had been neglected so long that wheels sank in the dust half to the hubs was hardened in two days by a double application of water. The roads are also King-dragged and crowned.

Last fall the experiment was tried of placing a large tank on a motor truck. The motor increased the mileage of road covered, saved time in refilling, and enlarged the radius of activity. F. A. Warren, county engineer, states that it is believed that the use of the motor will bring the cost of sprinkling down to about 30 cents per mile per day—a 70 per cent reduction in cost.

Some of the roads are surfaced with a single course of gravel laid about 8 to 12 in. deep on the natural soil. This gravel is nothing but good concrete stone, natural deposit, pit run, which ranges from a fine clean sharp sand the size of birdshot up to peas, marbles and finally to about 2½ in. hard granite. A few cobbles the size of paving blocks are found in the mixture. The gravel is not screened, but is dumped on the smoothed soil and spread with potato forks, the tines of which are bent to form rakes with 6-in. teeth. The fine gravel is raked to the top. Only unskilled labor was used. This work is done in the winter months when men and teams can be hired from the farmers at half pay. The cost of the gravel road varies from 23 to 45 cents per square yard, 1 ft. deep. It has been found that during the first year the gravel does not compact, except in the one well-traveled wagon track, but that after a summer's wear and a winter's moisture and King-dragging in the fall and spring a road such as shown in the accompanying photograph is obtained. This gravel road has been found to need little sprinkling, wears extremely well, and ruts inappreciably.



EARTH AND GRAVEL ROADS IN CHELAN COUNTY, WASHINGTON

Top view is of earth road, sprinkled and dragged; middle and bottom views are of gravel road, first and second years respectively

Co-operation Sought in Conducting Activated Sludge Experiments at Baltimore

Discussion of Design and Operation of Continuous Flow Aero Tanks Is Accompanied by Request for Suggestions and Criticisms

By LESLIE C. FRANK
Sanitary Engineer, U. S. Public Health Service,
Hygienic Laboratory, Washington, D. C.

and

CALVIN W. HENDRICK
Chief Engineer, Baltimore Sewerage Commission,
Baltimore, Md.

ENGLISH experiments on what is termed the "activated sludge process" of sewage aeration have been reviewed recently in the American engineering press. The importance of translating this process from the fill-and-draw to the continuous-flow plan and of bringing the cost of operation, by this and other improvements, into the region of workable values, is obvious. The fill-and-draw method, as applied to the activated sludge process, (a) consumes an amount of hydraulic head equivalent to the difference between the full and empty water levels; (b) produces a low operation efficiency because the filling, oxidation, settling and emptying processes are intermittent and must wait upon each other; (c) necessitates periods of non-oxidation which possibly reduce the efficiency of the activated sludge.

Principles of Tank Design

In an attempt to overcome these difficulties a type of continuous flow tank, termed the aero tank, was developed in December, 1914, at the Hygienic Laboratory of the U. S. Public Health Service. The considerations underlying this design are as follows:

(1) The oxidation process is promoted by the degree of fineness of the air or oxygen bubbles introduced into the oxidation chamber.

(2) The oxidation process is promoted by the degree of agitation of the contents of the oxidation chamber, this agitation keeping the particles of activated sludge suspended in the liquid. Agitation may be effected (a) by the impact of the inflowing sewage; (b) as a secondary function of the oxygen introduction device; or (c) as a primary function of special agitators, e. g. some propelling device enclosed, if desired, in a pipe to increase the radius of agitation.

(3) The activated sludge depositing in the settling chamber should be returned continuously into the oxidation chamber, both in order to prevent the depletion of the activated sludge in the oxidation chamber and to prevent secondary reactions of the activated sludge in the settling chamber.

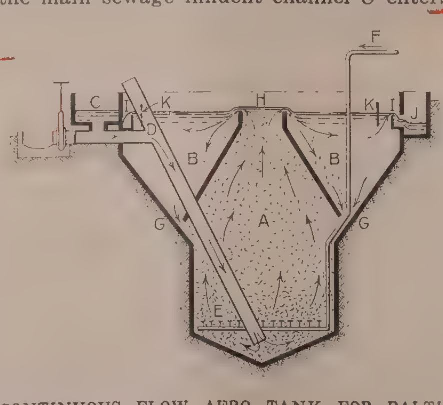
(4) The passage of oxidation chamber contents into the settling chamber should be effected in such a way as not to hinder the return of the sludge particles into the oxidation chamber.

A tank, therefore, to answer the above requirements, may be designed to consist of an oxidation chamber into which the sewage is continuously introduced, and the contents of which are continuously receiving oxygen in a finely divided state and being agitated; a settling chamber whose inner surfaces are so inclined as to prevent the accumulation of solids; a communicating passage to effect the transfer of oxidation chamber contents into the settling chamber without hindering the return of sludge particles; a communicating passage between the lowest portion of the settling chamber and the oxidation chamber.

Inasmuch as Imhoff tanks such as those nearing completion for the city of Baltimore may easily be converted for the above process, the Public Health Service and the Baltimore Sewerage Commission have agreed to make joint experiments for the purpose of testing on a large engineering scale the basic principle of the tank, so as to develop all possible defects and improvements.

This article, giving the first authoritative information regarding the details of the aero tank experiments on the treatment of sewage by the activated sludge process, which are now being conducted at Baltimore under the joint direction of the U. S. Public Health Service and the Baltimore Sewerage Commission, is written primarily to induce co-operation among engineers who are studying this important subject. Criticisms and suggestions are solicited in order that the Baltimore tests may have the benefit of the experience of all those who have done work or developed theories relating to this newest phase of the sewage treatment problem. Communications may be addressed to either of the authors.—EDITOR.

Several of the Baltimore Imhoff tanks are being converted for use in the experiments. One of the methods of operation to be experimented with is shown in the accompanying drawing. The details of operation are as follows: Sewage from the main sewage influent channel *C* enters the horizontal branch of the tank influent pipe *D*, flows through the pipe *D* to the bottom of the oxidation chamber *A* with a sufficiently high velocity to prevent the settlement of solids at the bottom of the tank. Rising through oxidation chamber *A*, and being continuously agitated, the agitation being aided if necessary by mechanical agitators, the sewage is brought into intimate contact with air or oxygen applied through air supply *F* and comminutor *E*. The absence of air bubbles in chamber *B* and the presence of air bubbles in the portion of chamber *A* above slot *G* is expected to cause the level of the liquid in vent *H* to rise above the level of the liquid in chamber *B*. This will cause all or part of the sewage to flow from *A* into *B* through vent *H* rather than through slot *G*, or, in fact, the flow through *H* may be increased to an amount greater than the amount of inflowing and outflowing sewage applied to the system as a whole, and hence cause a partial return flow from *B* to *A* through slot *G*. This partial return flow need not be dependent upon the air-lift function above described, but may be effected or aided by any other propelling means situated between the oxidation and sedimentation chambers. The particles of sludge which pass with the sewage through *H* into *B* will settle out in sedimentation chamber *B* and return through slot *G* to *A*, being aided if desired by the said return current. The oxidized and settled effluent from *B* will pass into the effluent collector channel *I* and thence out into the main system effluent channel *J*. *K* is a scum-board to hold back particles lighter than water.



CONTINUOUS FLOW AERO TANK FOR BALTIMORE SEWAGE TREATMENT TESTS

Another one of the Imhoff tanks will be converted exactly as above described, except that the air comminutor *E*, composed of discs of porous material, will be omitted and replaced by a propeller method of air comminution. This method has been suggested by John Neal, of the Baltimore Sewerage Commission staff, and consists in producing finely divided air by the action of a rapidly revolving propeller in simultaneous contact with both air and water. The propeller will be placed either in the sewage influent pipe or in a special pipe situated in the oxidation chamber. The propeller may be used at the same time to promote or effect agitation.

Schedule of Experiments

The proposed schedule of experiments includes the determination of:

(1) The best method of introducing the sewage into the oxidation chamber.

(2) The best method of comminuting air in water.

(3) The best method of agitating the contents of the oxidation chamber.

(4) The optimum period of detention in the oxidation chamber.

(5) The best method of effecting passage from the oxidation chamber into the settling chamber.

(6) The optimum period of detention in the settling chamber.

(7) The characteristics of the oxidized and settled effluent.

(8) The amount of air necessary per unit of sewage.

(9) The best method of sludge withdrawal and subsequent sludge treatment or utilization.

(10) The characteristics of activated sludge.

(11) The best manner of initial activated sludge formation.

(12) Possible remedies for defects that may develop in the course of experiment.

(13) An estimate of construction costs per unit of population and per unit of sewage flow.

(14) An estimate of operation costs per year per unit of population and per unit of sewage flow.

This article is written primarily to induce co-operation. Undoubtedly a number of experimenters in the United States have become interested in the apparent possibilities of the activated sludge process, and unnecessary duplications of effort may be avoided if free communication be established between such experimenters. The authors hereby invite co-operative suggestions and exchange of results under the following conditions:

All communications should be in writing and addressed to either of the authors.

All communications will be acknowledged.

The periodic exchange of results will be undertaken with those actively engaged in this line of research.

Such suggestions from outside sources as are found in the experiments at the Baltimore plant to prove important modifications or additions to the basic principle are to form material which may be used, if desired, for patents free to the people of the United States, due acknowledgment being given the authors of such suggestions.

Wheelbarrows and Scrapers Preferred for Mississippi Levees

As to the relative value of levees built with wheelbarrows, scrapers, or mechanical earth-handling devices there is much difference of opinion among engineers. The following views on the subject were expressed by Sidney F. Lewis, chief engineer of the Board of Levee Commissioners, Orleans District, in discussing a paper presented March 9 before the Louisiana Engineering Society by Major Frank M. Kerr:

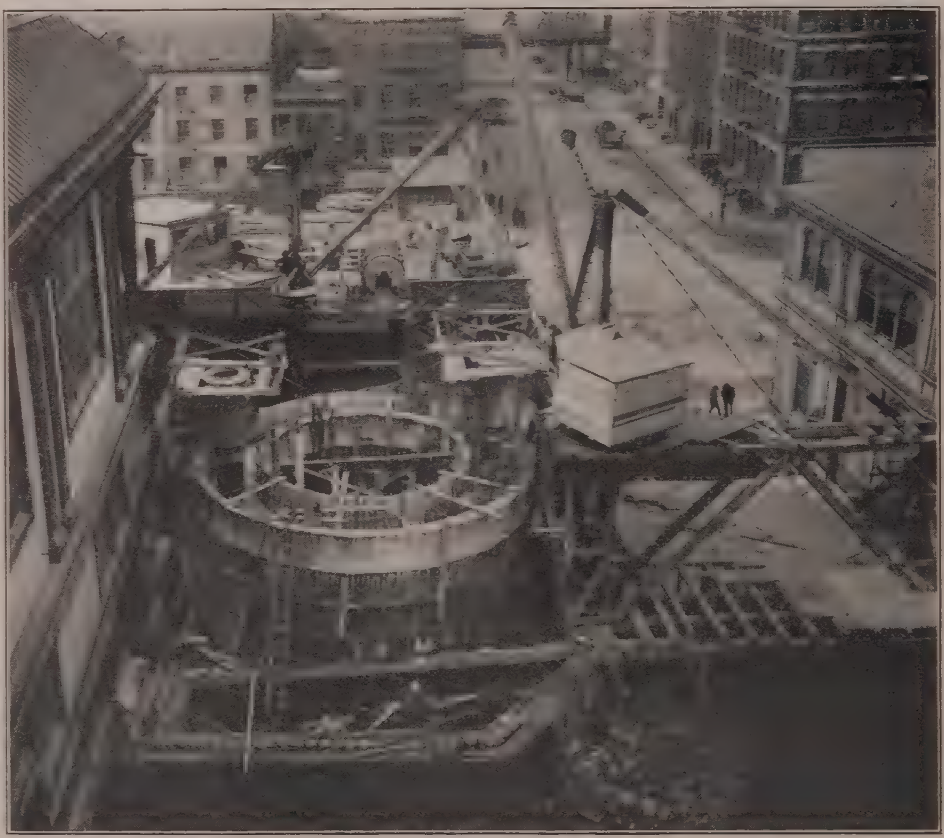
"Wheelbarrow work is slow, scraper work will do for levees of certain dimensions, and machinery built levees have cheapened very much the cost of work. In my judgment the wheelbarrow and scraper are not as yet to be superseded in toto by the present methods of construction of levees with machinery. The wheelbarrow and the scraper will build the embankment to the necessary height in layers as it should be, distributing the material uniformly from base to base. To do this by the present mechanical devices in many cases is simply impracticable, and in consequence in levees built by machinery there is less homogeneity in the particles of earth composing the mass of the embankment. The shrinkage is equally as great as in wheelbarrow work, the rain wash is equally as great as in scraper work and more so than in wheelbarrow work, but above all is the unequal distribution of material, a danger of overloading the crust of solid earth that has to sustain the weight of the material, and the result of a rupture of foundation, and then trouble galore.

"This result is shown today by machine-built levees at Caernarvon on the east bank of the river, and at Couret on the west bank. I do not mean to infer that it should be prohibitive to build levees by the present mechanical devices, but I do say from my experience that the right kind of a machine to build a levee, and comply with the specifications required in the construction of an embankment to retain the floods of the Mississippi River has not yet been devised. I believe, however, in the near future that a levee-building machine will be evolved that will comply with all the requisites in handling earth and distributing it in uniform layers as required in an embankment that serves the purpose of prevention from overflow."

Unexcavated Core Is Left in Center in Sinking Circular Subway Shaft

Saving of 700 Yards in Material Excavated Under Air—Concrete Placed by Chute from Elevated Mixer to Which Derrick Raises Dry Batches

The cost of sinking permanent shaft 4 at the foot of Broad Street, New York City, for the construction of the Brooklyn Rapid Transit Tunnels under the East River was cut by excavating under air only a ring beneath the outside wall of the circular caisson, and leaving the core inside the ring to be removed after the caisson was sealed to rock. The quantity of material excavated per vertical foot of sinking under air was in this way reduced from 35.6 cu. yd. to 16.9 cu. yd., leaving a total volume of earth and rock in the core of more than 700 cu. yd.



THIRD RING CONCRETED AND CHUTE FROM MIXER TAKEN DOWN

Notice angles on outside forms and pile bulkhead surrounding island built to start caisson

An island made by filling dirt and small stone inside a pile and timber coffer, built in the slip, was used to set up the working chamber and start the caisson.

Design of Caisson

The construction of the caisson is clearly shown in the accompanying drawing. It was designed to be sunk an average depth of 27 ft. to rock, and then into rock until its cutting edge reached an elevation of 37½ ft. below mean high water, giving a least penetration into rock of 6 ft. Five feet more was then excavated under air below the cutting edge and filled with concrete, to make sure of a tight seal.

Erection of the cutting edge was begun March 9. As soon as this was finished, forms were set up and a ring 16 ft. high was concreted. Sinking was then begun and carried on until the top of this ring was 2 or 3 ft. above ground, when air was taken off while concrete for a second ring was poured. After this sinking went right on while the forms were being changed and the third and last ring concreted. The outside forms had angle-iron ribs, while the inside forms were braced with plank segments.

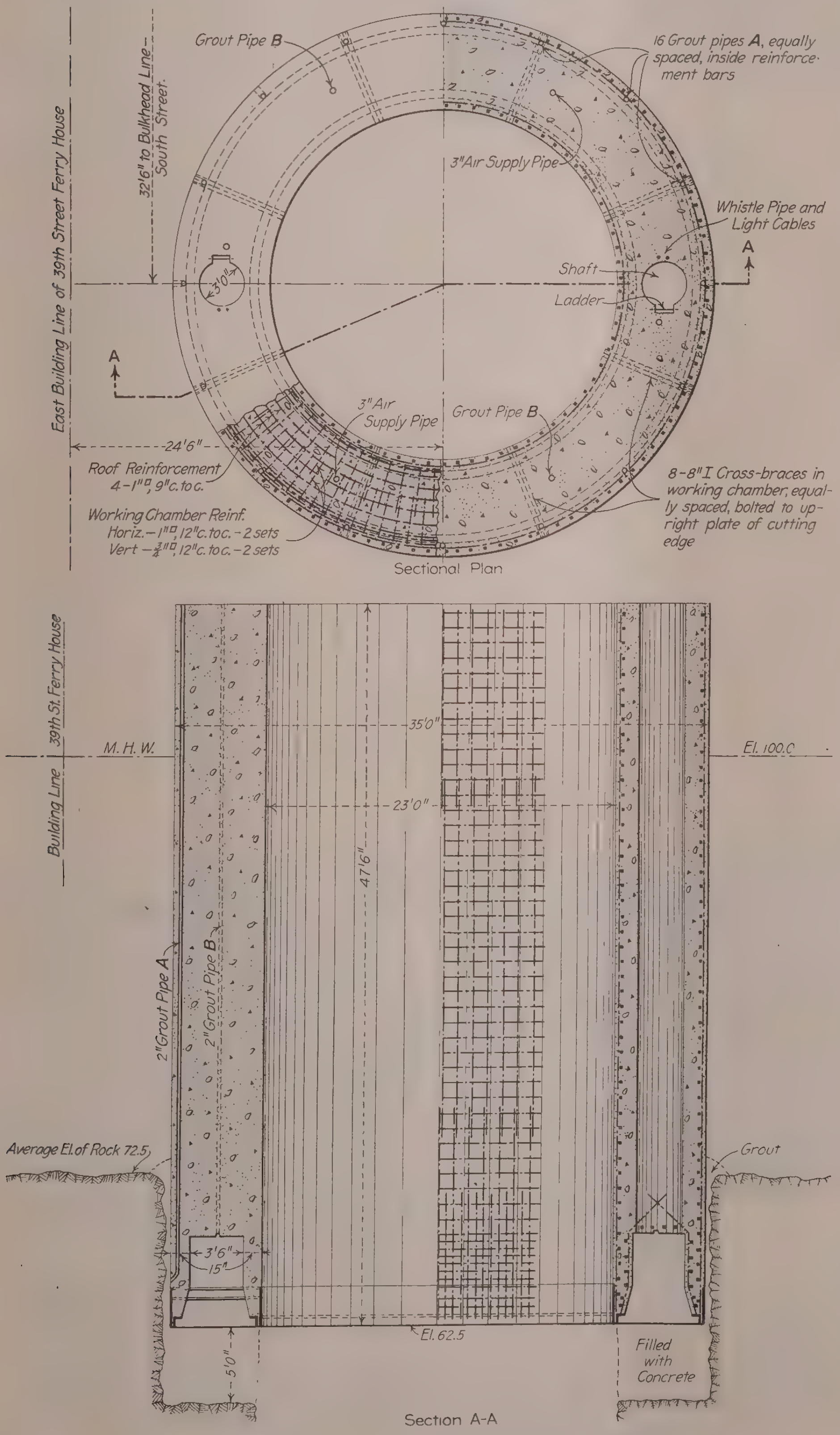
Concrete Layout

The overhead structure shown in the background of the photograph will carry disposal tracks, concrete plant, etc., for the tunnel construction. As it was already in place to carry one of the derricks employed in sinking the shaft, it was found convenient to set the mixer on top of it, where concrete could be spouted directly into the forms. The concrete materials, however, were delivered by team and barges at street level. To get this material to the mixer the derrick was used. Dry batches, with cement on the bottom, measured in wheelbarrows, were dumped into a ½-yd. bucket and raised to the mixer by the derrick at the left of the photograph. As the derrick lines could be marked for the loading platform and the mixer, work went much faster than if the mixer had been set at street level and the derricks used to pass wet concrete around the forms; especially as this would have required exchanging buckets between the two derricks. The output of this ½-yd. mixer ran as high as 100 yd. in 8 hours.

It might be expected by those familiar with shaft sinking that the additional friction from inside the shaft would have required considerable weighting of the caisson. This, however, was not the case, because of the greatly reduced uplift from air pressure, the comparatively shallow depth to which the caisson was sunk, and the fine, loose nature of the soil penetrated. The caisson, when finally built up, with locks in place, weighed probably 1060 tons. The area on which upward air pressure acted was about 456 sq. ft., while it would have been 962 sq. ft. if the space inside the caisson had been decked. At 18 lb. per square inch, the maximum pressure required in sinking, the total uplift was only 590 tons, leaving 470 tons effective weight to overcome skin friction. Blocking was required at all times in the rock work to prevent a premature drop, and the caisson went down, after the second ring had been concreted, without its being necessary to reduce the air pressure by "blowing."

Rock Excavation

The rock excavation was done with jackhammers and light shots. Two or three pits, full width of the working chamber, were kept in advance of the cutting edge, and the material broken into them from the ends. Each of the three 8-hr. shifts had from two to four men engaged in drilling, and shots were fired two or three times per shift. Enough material was broken up in this way to keep the buckets going continuously, and that with a comparatively small number of drills in the hole. Shots were fired from the airlock, and a few minutes' "blowing" of the caisson was needed to clear the working chamber of gas after each shot. There was room enough in the head of the slip around the shaft to dispose of all the material taken out in sinking, and removing spoil from the site will not be necessary until open excavation begins.


Grout Pipe B
16 Grout pipes A, equally spaced, inside reinforcement bars
32'6" to Bulkhead Line—South Street.
East Building Line of 39th Street Ferry House
3"Air Supply Pipe
Whistle Pipe and Light Cables
A
Shaft
Ladder
5'0"
A
3"Air Supply Pipe
Grout Pipe B
24'6"
Roof Reinforcement 4-1"□, 9"c.to c.
Working Chamber Reinf. Horiz.-1"□, 12"c.to c.-2 sets Vert-¾"□, 12"c.to c.-2 sets
8-8"I Cross-braces in working chamber, equally spaced, bolted to upright plate of cutting edge
Sectional Plan
Building Line 39th St. Ferry House
M.H.W.
35'0"
23'0"
47'6"
El. 100.0
2"Grout Pipe A
2"Grout Pipe B
Average El. of Rock 72.5
Grout
3'6"
15"
El. 62.5
5'0"
Filled with Concrete
Section A-A

ANNULAR CONSTRUCTION SAVED EXCAVATING 700 YARDS UNDER AIR

The row of grout pipes marked "A" on the drawing will be used to make a tight seal between the sides of the caisson and the rock, which with the 5 ft. of concrete below the cutting edge should make a very effective seal. The row of grout pipes marked "B" will be used to fill the space under the roof of the working chamber, after the working chamber has been concreted by hand.

The Flinn-O'Rourke Company, Ltd., is the contractor for the East River tunnels, and work on them is under the charge of A. A. Brewer. J. C. Maitland is superintendent at the shaft. For the Public Service Commission, George S. Rice is engineer of the first division, and William H. Snow is section engineer at the shaft.

Elements of Railroad Value That Might Be Overlooked

Valuation Committee of Cincinnati, Hamilton & Dayton Railway Issues Bulletin Listing Sixty-two Such Items

OCTOBER 3, 1914, the Engineering Record published on page 387 an abstract of an official bulletin issued by the chairman of the valuation committee of the Central Railroad of New Jersey setting forth information desired for the Federal valuation, and especially information as to obscure items. Ample as this seemed to be, the valuation committee of the Cincinnati, Hamilton & Dayton Railway, consisting of H. R. Talcott, chairman; J. D. McCubbin, Jr., real estate agent; Jenks B. Jenkins, valuation engineer; R. Marsden Smith, counsel, and J. J. Ekin, secretary, has issued one much more comprehensive, embracing numerous items not mentioned in the earlier bulletin, and amplifying on others. The poster is 12 x 24 in., printed in large type. After pointing out the danger of many items forgotten and no longer visible being overlooked, and urging that all who have personal recollection of such items to bring forward their information, the committee gives the following "partial list of items about which information is desired":

1. Notebooks, maps, profiles, plans and records of construction, final estimates, vouchers, reports of engineers, "authority for expenditure" reports or similar records in the offices of the company, or in the possession of contractors or others, whether or not in the employ of the company.

2. Surveys made before or during construction.

3. Requirements and expenses in the acquisition of right of way, such as drains, cattle passes, bridges or other improve-

ments built or grading done on adjacent land; bonuses paid in addition to deed consideration; consideration for abandonment of crossings or relinquishment of other requirements in deed; annual or perpetual passes granted; other considerations of value not mentioned in deed; transportation and subsistence of witnesses, witness fees, court costs, etc. Fences or crossings constructed either by provision in deed or otherwise.

4. Special construction under roadbed embankments through swamps and marshy ground, such as log and brush mattresses, corduroy, etc.

5. Sink holes, filling or settlement of abandoned mines, embankments that have slid away into rivers or otherwise out of place or slowly sliding or settling embankments requiring occasional refilling.

6. Slides, washouts, fires, wrecks, injuries to persons, equipment lost or damaged, calamities, etc., during construction.

7. Hills that have been entirely removed, or hollows that have been filled in grading, in connection with roadbed, station grounds or yards.

8. Unusually difficult materials encountered in grading, not now evident, including frozen material excavated or unloaded.

9. Cuts originally wet but afterward dried out.

10. Solid rock, loose rock, hard pan, quicksand, cemented gravel or other special classification of materials excavated, especially when such material is not distinctly visible.

11. Borrow pits, not easily discoverable, from which material has been taken for roadbed or ballast. Waste banks.

12. Clearing and grubbing originally done that might be overlooked on account of the adjacent land now being cleared.

13. Special construction for roadbed protection, such as piling, cribs, mattresses, riprap, sea walls, retaining walls, etc., not now visible or easily discoverable.

14. Changes in highways and roads.

15. Changes in channels of streams and canals to reduce the number of bridges, prevent overflow, make room for roadbed, etc.; dredging in channels.

16. Temporary tracks, trestles, etc., on account of highway or channel diversions or to take care of traffic during construction.

17. Buildings, bridges or other structures moved or torn down during construction.

18. Rock, corduroy or other special material under ballast in cuts or elsewhere, or special construction of any kind due to soft material under track.

19. Materials employed to prevent the formation of water pockets in widening or raising grade or for other purposes.

20. Materials exceptionally employed in raising track under traffic.

21. Approaches to grade crossings, over or under crossings or highway bridges not easily seen to be a part of the construction of the railroad.

22. Streets or structures raised or lowered to obtain greater clearance or for other reasons.

23. Old excavations filled up.

24. Rock excavated while adjacent track was in use.

25. Night work done during construction.

26. Bonuses to contractors.

27. Grade revisions where no change of alignment was made.

28. Exceptionally long hauls on earth, ballast, etc.

29. Abandoned roadbeds or other property not easily seen.

30. New lines or structures begun and not completed.

31. Construction or improvements on which work was suspended and then resumed.

32. Extra watchmen, switch tenders, signalmen, etc., employed during construction.

33. Difficulties and unusual conditions experienced in the construction of tunnels.

34. Dikes, riprap, dams and other work on streams for the protection of bridges or riprap around piers and abutments, which might be overlooked.

35. Enlargement of Government or other levees.

36. Difficulties and unusual conditions experienced in the construction of old bridges, culverts and buildings, especially in the foundations for the same, as in case of striking quicksand, etc. Cofferdams, caissons, etc.

37. Foundations of old structures which are of unusual depth or size or contain piles or other forms of construction which would not ordinarily be suspected.

38. Culverts, drains, conduits, sewers, water pipes, etc., which are not readily discoverable, and especially those built by the company which are outside the right of way. Subdrains in cuts and elsewhere which would likely be overlooked.

39. Wagon bridges not over tracks.

40. Waterproofing of masonry.

41. Preliminary investigations with reference to foundations, test pits, borings, etc.

42. Foundations or other construction done for future development.

43. Girder rail or other rail of special weight or section, put in on account of street paving or other special conditions, and not readily distinguishable from ordinary rail.

44. Materials, originally ballast, which have settled below subgrade.

45. Track changes during construction.

46. Gage widened or reduced.

47. Third rail (compromise gage) laid or removed.

48. Second, third or fourth main track constructed.

49. Curbing, paving or repaving of streets, construction of side walks, water lines and sewers or drains in towns and cities done or paid for by the railroad company and other special assessments against the railroad company.

50. Trestles filled in, culverts covered up, bridges shortened and partly replaced by embankments, bridges lengthened, requiring rebuilding of piers or abutments, etc.

51. Unusual difficulties in connection with the development of water stations and water supply.

52. Wells dug or drilled and afterward abandoned on account of poor quality or insufficient quantity of water obtained.

53. Dredging channels in navigable waterways or elsewhere.

54. Bulkheads not visible on account of new bulkheads being built farther out in stream.

55. Conduits, underground cables, submarine, cables, etc.

56. Gage of equipment changed.

57. Antiquated equipment or machinery stored in out-of-the-way places.

58. Temporary yards for storage of construction material.

59. Temporary water tanks or other structures during construction.

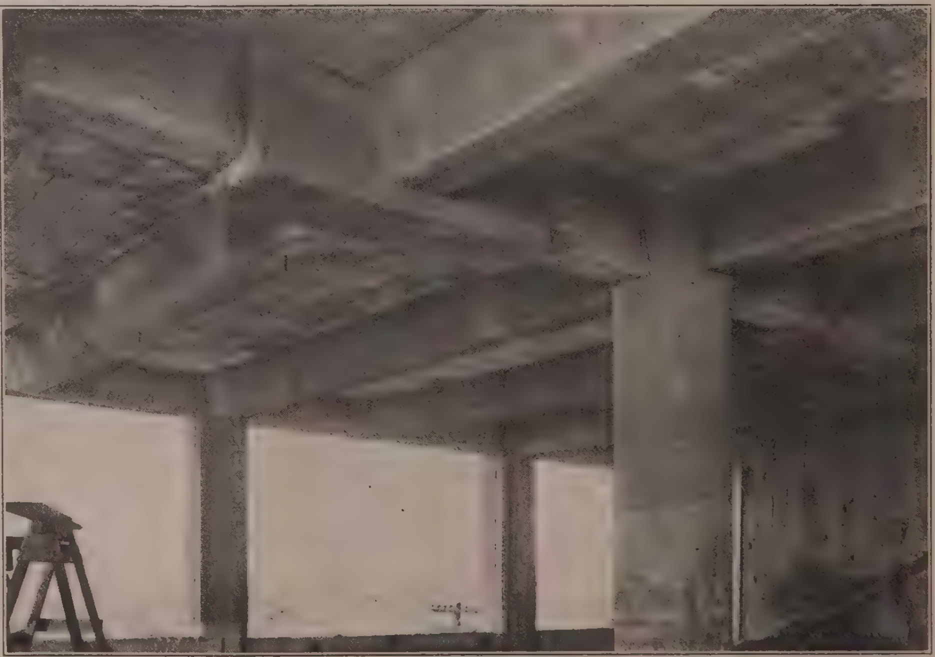
60. Temporary leases of property in connection with construction.

61. Franchise payments.

62. Records, papers or memoranda relating to the organization or construction of the railroad.

Repairs to Girder Shattered in Edison Fire

THE ACCOMPANYING photograph, showing how a shattered girder weakened through the section of greatest bending moment was reinforced at the plant of Thomas A. Edison, Inc., West Orange, N. J., was received too late for insertion last week in the article describing the methods of repair at that plant. A drawing in that article showed the details of this construction, in which tension steel, as well as angles directly beneath the slab, is added.



CONCRETE GIRDER REINFORCED AT PLANT OF THOS. A. EDISON, INC., WEST ORANGE, N. J.

Earth Fill Replaces Trestle for Irrigation Canal

Short-Lived Structure Over Gulch Eliminated by Hydraulic Embankment with Concrete Flume, Turlock Irrigation District

OLD TRESTLE OVER DELANEY GULCH REPLACED BY 76-FOOT FILL

TEN YEARS is considered about the average serviceable life of the timber trestle used extensively in the West to carry irrigation canals across ravines. The flumes of the main canal of the Turlock Irrigation District in Stanislaus and Merced Counties, California, are 20 ft. wide and 8 ft. deep, and it has been deemed economical to replace the trestles with earth embankments wherever practicable and substitute concrete for timber flumes on these embankments. The first fill of this character is across Delaney gulch, about 30 miles east of Turlock and 2 miles southwest of the town of La Grange. It has a maximum height of 76 ft., a width of 64 ft. and side slopes of 1 on 2. The material in the fill amounts to 204,220 cu. yd. The fill was made by sluicing.

Sluicing the Embankment

For the lower portion of the embankment suitable material was obtained from a borrow pit within 600 ft. of the toe. It consisted of a mixture of 20 per cent gravel and 80 per cent clay, which was first loosened with black powder and then sluiced with a Joshua Hendy monitor to the distributing flume. This was first built with a grade of 5 per cent, but later the pitch was increased to 7 per cent, as the heavier material could not be sluiced down the original grade. The dimensions of the flume were 10 x 16 in. and the average ratio of silt to the water used in conveying it was 3 to 10 parts by volume. Due, however, to the varying proportions of gravel in the aggregate the ratio often varied from 15 to 60 per cent.

As the height of the embankment increased it was necessary to abandon the first borrow pit and convey material from a greater distance. Sluicing was therefore begun at a second pit more than 1000 ft. from the fill. A tunnel 90 ft. in length, through which the distributing flume was led, was necessary, because of an intervening ledge of soft sandstone. From the pit to the tunnel 22-in. light steel pipe was used instead of a flume, as it could be moved more readily.

The Pumps

Water for sluicing was led from the main canal to a sump over which two high-duty Lea pumps were located. The sump was 100 ft. below the monitor, which was connected by a 6-in. steel pipe to one of the pumps. This was a three-stage turbine operated by a 150-hp motor at 1800 r.p.m. The suction pipe tapered 24 to 14 in. and was primed by an air-pump run by a 1½-hp. motor. A second turbine pump, operated by a 100-hp motor at 1150 r.p.m., discharged into a 10-in. steel pipe which supplied additional water directly into the borrow pit. The monitor nozzle was 1½ in. in diameter and the normal pressure from the single turbine was 150 lb. per square inch. When a greater pressure was necessary for disintegrating the material the discharge from the 10-in. pump could be connected to the suction pipe of the 6-in. turbine and both operated together as a two-stage battery, which furnished a pressure of 225 lb. at the monitor. Power was supplied at 2 cents per kilowatt-hour from the 30,000-volt transmission line of the Yosemite Power Company, and transformed at the pumps to 440 volts.

Eight discharges, four on either side of the main distributing flume, emptied on the embankment. Waste water was carried off through a vertical outlet 2 ft. square, connected to the main concrete culvert through the fill. Sheerboards 1 x 12 in. x 8 ft. were used for distributing the sluiced material.

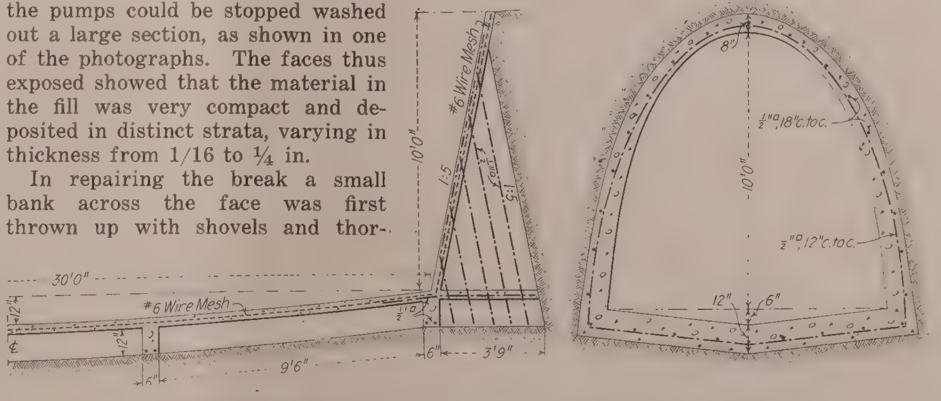
Repairing a Break

On Oct. 16, 1913, waste water which had collected on top of the embankment seeped through the front, and before the pumps could be stopped washed out a large section, as shown in one of the photographs. The faces thus exposed showed that the material in the fill was very compact and deposited in distinct strata, varying in thickness from 1/16 to ¼ in.

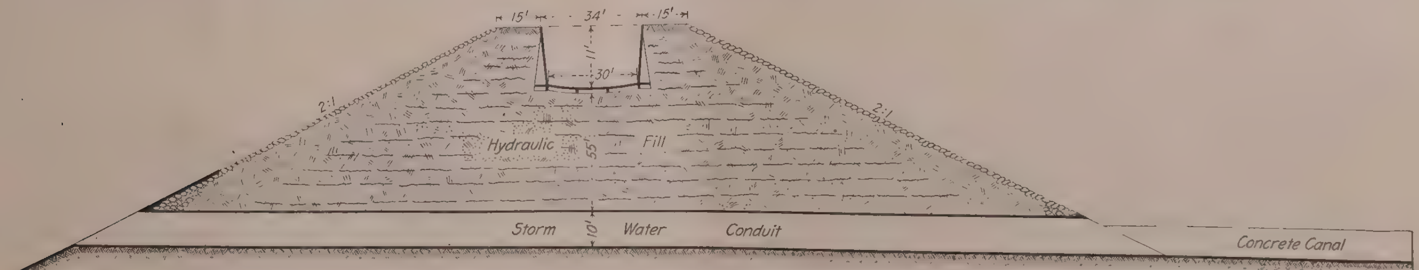
In repairing the break a small bank across the face was first thrown up with shovels and thoroughly tamped. Through this a 1 x 2-ft. culvert provided for the escape of waste water. The monitor was again started, and a very little additional water from the 10-in. pipe added at the pit. A mixture containing 50 per cent silt was deposited behind the shoveled bank, and as the deposit increased in height a vertical waste-water outlet was provided, connecting with the nearly horizontal culvert through the foot of the bank. In this manner the break was very rapidly repaired at a comparatively small expense. An average of 2000 cu. yd. was deposited daily.

The work was run continuously with three 8-hour shifts. Each shift was composed of a foreman, three powder men and four sluice men in the pit, a foreman and six laborers on the embankment and an engineer to run the pumps. The services of four carpenters were available whenever needed. For illuminating the work at night two 1000-candlepower Milburn acetylene lights were used.

The contract price for embankment was 30 cents per cubic yard and for concrete in the culvert and face lining $25 per cubic yard in place. Gravel for the concrete was hauled 2 miles, from a pit on the bank of the Tuolumne River. Lumber



CROSS-SECTIONS OF OPEN FLUME AND OF STORM WATER CONDUIT



CROSS-SECTION OF DELANEY GULCH EMBANKMENT ON CENTER LINE OF 10-FOOT STORM WATER CONDUIT was hauled 30 miles from the car at Turlock and cost approximately $27 per thousand feet, b. m., delivered on the work. Rock for the riprapped face was obtained within 1500 ft. of the work, and was mined and put in place for 5 cents per square foot of riprapped surface.

For the Turlock Irrigation District, Burton Smith, chief engineer, had charge of the work, which was performed under contract by Edward Malley, president of the Coast Improvement Company.

SECTION OF DELANEY GULCH FILL WASHED OUT DURING CONSTRUCTION

Iron in Water

HALF a part per million of iron in water is detectable by taste, and more than 4 or 5 parts makes water unpalatable, according to water supply paper 273, recently issued by the U. S. Geological Survey. More than 2.5 parts per million in water used for laundering makes a stain on the clothes. Iron must be removed from water from which ice is made, or a cloudy, discolored product will result. An iron content of over 2 or 3 parts per million in water used in the manufacture of paper will stain the paper. Waters having a high iron content have in some places, where they have been used as city supplies, caused an immense amount of trouble and expense, for they favor the growth of Crenothrix to such a degree that the water pipes become clogged with the iron sheaths of that organism.

THE WATER HYACINTH has proved a serious obstruction to navigation in Florida and Gulf waters, and its removal has caused the engineers of the War Department considerable study, and cost the United States Government much money. War on this plant was begun on the St. Johns River in 1899. The best method of attack has proved to be raising masses of the plants from the water with a belt conveyor mounted on a barge, and dumping them either on the bank, or well out in the current, where they will be carried to sea. Spraying the plants with compounds of arsenic has also been tried, but in the Florida waters this proved dangerous to live stock. Since the extermination of this plant was first undertaken $138,000 has been spent for this purpose in Florida alone.

Assigned Work of Railway Engineering Association

Board of Direction Announces Instructions for the Coming Year to the Nineteen Standing and Three Special Committees

ASSIGNMENTS of work for the coming year for the nineteen standing and three special committees of the American Railway Engineering Association have been announced. To a large degree these are instructions to continue investigations already under way, but there are also numerous new studies proposed. The assignments, in addition to one to each committee directing it to make critical examination of the subject matter in the "Manual," are as follows:

Roadway.—Continue the study of unit pressures allowable on roadbed of different materials, co-operating with special committee on stresses in railroad track.

Report on the prevention and cure of water pockets in roadbed.

Ballast.—Report on the economical and efficient depth of ballast, co-operating with special committee on stresses in railroad track.

Methods and cost of applying ballast:

(a) Ballasting by contract.

(b) Mechanical tamping and shoulder formings.

Efficiency of various stone and gravel ballasts.

Ties.—Report on the effect of tieplates and track spikes on life of crossties.

Specifications for cross and switch-ties.

Metal, composite and concrete ties.

Rail.—Report on rail failures, statistics and conclusions.

Report on effect on rail of defective equipment and improper maintenance.

Continue special investigation of rails.

Track bolts and nutlocks.

Track.—Continue the study of economics of track labor.

Study the relation between worn flanges and worn switch points, with a view to correcting the causes and decreasing the number of derailments due to the combination of worn switch points and worn flanges on wheels.

Present specifications and designs for cut and screw spikes.

Report on guard rails and flangeways and effect of increase of ⅛-in. thickness of wheel flanges.

Buildings.—Report on coaling stations.

Report on freight house scales.

Report on ashpits.

Wooden Bridges and Trestles.—Continue the study of design of docks and wharves.

Report on comparative merits of ballast-deck and reinforced-concrete trestles.

Continue the study of the use of lag screws in trestle construction.

Masonry.—Report on cost and method of constructing concrete piles.

Report of cost, appearance and wearing qualities of surface finish of concrete.

Report on design of foundations for piers, abutments, retaining walls and arches in various soils and depth of water (not including pneumatic foundations).

Signs, Fences and Crossings.—Report on principles governing the use of railway signs.

Continue the study of concrete fence posts.

Signals and Interlocking.—Continue the study of economics of labor in signal maintenance.

Report on signal installations on single-track roads.

Present, for approval, specifications adopted by the Railway Signal Association, which, in the judgment of the committee, warrant consideration.

Requisites for switch indicators, conveying information on condition of the block to conductors and enginemen.

Records and Accounts.—Report on the use of small forms on cardboard or other suitable material for use of field men in making daily reports, to the end that supervision may be facilitated and efficiency encouraged.

Continue the study of feasible and useful subdivisions of Interstate Commerce Commission classification accounts 202 and 220, with a view to securing uniformity of labor costs, separating the items in accordance with such forms as are promulgated by the Interstate Commerce Commission during the year.

Investigation of methods for reproducing maps and profiles on drawing linen for permanent record.

Rules and Organization.—Report on clearance for maintenance of way structures under assignment from the committee on maintenance of the American Railway Association, conferring with other committees.

Continue the formulation of rules for the guidance of field parties.

Continue the study of science of organization.

Water Service.—Report on cost of pumping water by various methods.

Report on protection for water stations against freezing.

Yards and Terminals.—Report on handling of freight in double-deck freight houses and cost of operation.

Continue study of typical situation plans of passenger stations and approaches, and methods of operating same.

Continue the study of classification yards.

Iron and Steel Structures.—Continue the study of methods of protection of iron and steel structures against corrosion.

Continue the study of the relative economy of various types of movable bridges.

Continue the study on secondary stresses and impact.

Continue the study of column tests.

Economics of Railway Location.—Establish a rational basis for determining the relative efficiency of various locations.

Report on effect of curvature on cost of maintenance of way and equipment.

Report on train resistance at speeds exceeding 35 miles per hour.

Report on fuel consumption per horsepower-hour.

Wood Preservation.—Continue the study of the effect of water in creosote.

Continue the study of the relation of amount of preservative and depth of penetration to the resistance of materials against decay, and also the penetration of preservatives.

Continue the compilation of service test records.

Report on drying process of wood preservation.

Electricity.—Continue the study of the subject of clearances of third rail and overhead structures, conferring with other committees.

Continue the study of electrolysis and insulation and its effect upon reinforced concrete structures.

Report on water power for electrical railway operation.

Continue the study of maintenance organization with relation to track structures.

Conservation of Natural Resources.—Continue the study of tree planting and general reforestation.

Present specifications for southern yellow pine, conferring with other committees and associations.

Continue the study of resources of iron ore, coal, fuel oil and timber.

Report on water power for railway electrical operation.

Uniform General Contract Forms.—Report on siding agreements.

Report on agreement forms for interlocking and railway crossings, conferring with committee on signals and interlocking.

Grading of Lumber.—Report on grading rules for white and Norway pines.

Specifications for southern yellow pine. (A. S. T. M.)

Specifications for timber to be treated in co-operation with the committee on wood preservation.

Stresses in Track.—No new assignment.

There are a few changes in the personnel of the committees, including one chairmanship, but in general the committees remain the same.

Concrete Column Tests Disclose Effects of Longitudinal and Spiral Reinforcement

Tests Made for American Concrete Institute Show Consistent Results for Variation of Strength with Percentage of Steel

FULL-SIZE TESTS of twenty-four large concrete columns with varying percentages of longitudinal and spiral reinforcement, reported by a committee of the American Concrete Institute, show consistent increase in strength with larger steel percentages and confirm the values used in current practice. Complete strain measurements, both longitudinal and lateral, show local differences in strains at different positions along the length of the column, and indicate that Poisson's ratio (ratio between lateral and longitudinal unit strains) is apparently about ¼ or 1/5 for low stress intensities.

Construction of Test Specimens

The columns were all made by the Turner Construction Company, of New York, using a 1:1½:3 mixture of standard Portland cement, sand and gravel; the same plant and workmen were employed as in the construction of a warehouse in New York City. The columns were shipped to Pittsburgh and tested in the 10,000,000-lb. testing machine at the Bureau of Standards. As indicated by the sections shown on the following page, all columns were about 20 in. in outside diameter, except the two 24-in. columns with a 2-in. outside fireproofing layer.

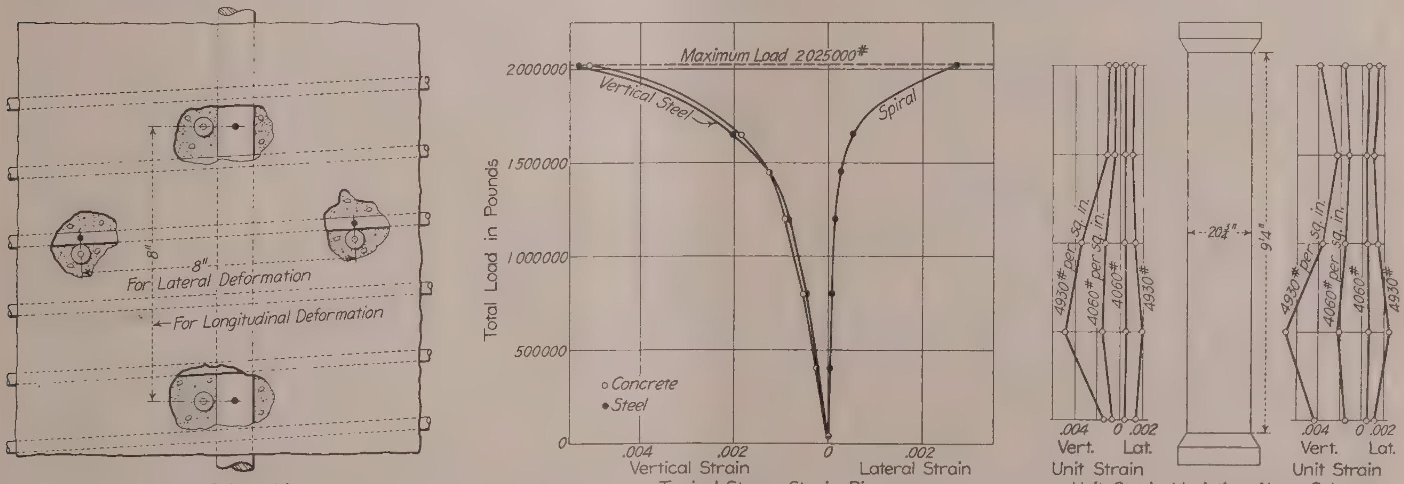
The spiral reinforcement consisted of ⅜-in. and ½-in. Bessemer rod which tested to average values for elastic limit and ultimate strength of 60,000 and 85,000 lb. per square inch respectively. The longitudinal reinforcement generally consisted of 1-in. or 1 7/16-in. round bars averaging 37,000 and 59,000 lb. per square inch for elastic limit and ultimate strength. These bars were milled to an exact length of 11 ft. 11 in. The columns were cylindrical for a length of 9 ft. 4 in., and enlarged at each end. It should be noted that the ratio of length to width was only about 5½ for the cylindrical section.

Details of Tests

Two standard cylinders were cast at the same time as each column and tested at practically the same age, i.e., at from 101 to 122 days after pouring. The temperature of the air, in Fahrenheit, on the days the columns were poured was as follows: Nov. 19, 59 deg.; Nov. 22, 56 deg.; Nov. 26, 46 deg. In order to protect the columns from the freezing weather which came before they were shipped, they were covered with tarpaulins, and a salamander was kept burning in the inclosure to maintain a temperature of 50 deg., except during the time between Dec. 1 and Dec. 23. From Dec. 1 to Dec. 23 and also from Jan. 3 to Jan. 19, while the columns were being loaded and shipped to Pittsburgh, the columns and cylinders were exposed to moderate winter weather.

The columns and cylinders were shipped to Pittsburgh and unloaded without apparent damage. The columns were then stored on the testing floor of the Bureau of Standards laboratory. As the temperature of this room was frequently very low, especially at night, the columns were grouped close together and entirely inclosed by canvas. Gas was burned within the inclosure for several weeks, and a moderate temperature maintained. It is believed that the conditions for hardening in the 115 days which elapsed between making and testing were less favorable than may be expected with a temperature of 65 or 70 deg. Fahr. maintained for ninety days.

The preparation of the columns for testing consisted in cutting into the concrete to expose the reinforcement and give opportunity for measuring the deformation in the reinforcement, setting steel plugs firmly in holes drilled in the concrete in the proper positions for the measurement of deformation of the concrete, and in the drilling of the gage holes. Relative locations are indicated in the figure herewith.



Layout of Gage Lines

Typical Stress-Strain Diagram

Unit Strain Variation Along Column

TYPICAL DIAGRAMS FOR VARIATIONS OF VERTICAL AND LATERAL STRAINS WITH STRESS AND ALONG COLUMN

Results of Tests

Except for the cylinders cast of the concrete used in the plain columns, the tests of standard cylinders gave uniform results averaging about 3000 lb. per square inch compressive strength. One of the plain concrete columns was evidently inferior in quality, as both cylinders and column failed at about 2500 lb. per square inch.

Tests were made of column sections classed in five groups to show the effects of variables: Group 1, 1 per cent spiral steel with vertical steel the variable; group 2, effect of increasing percentage of spiral steel; group 3, effect of protective concrete shell; group 4, plain concrete; group 5, effect of increasing percentage of vertical steel. Below the accompanying sketches of the sections is given a table showing the number tested and the average ultimate strength resulting from the tests. The individual values have been plotted on the diagrams reproduced here to indicate the variation with increase in steel, in one case with change in longitudinal, and in the other case with change in spiral reinforcement. Attention should be called to the abnormally high value of 4200 lb. for one column having 1 per cent steel in group 5, which raised the average for that case above that for 2 per cent steel.

The accompanying diagrams indicate typical results of the strain measurements. The stress-strain diagram shows the characteristic curved line variation, and also indicates a very close agreement between the strains in the concrete and in the steel, possibly due to the location of the plugs used for the concrete measurements. The diagrams showing variation of unit strain along the length are drawn for two opposite sides of the column. It is clear that the differences are small until the stress approaches the ultimate. These diagrams were drawn for a column having 2 per cent vertical steel and 1 per cent spiral steel. The following discussion of the results is substantially as given by the committee.

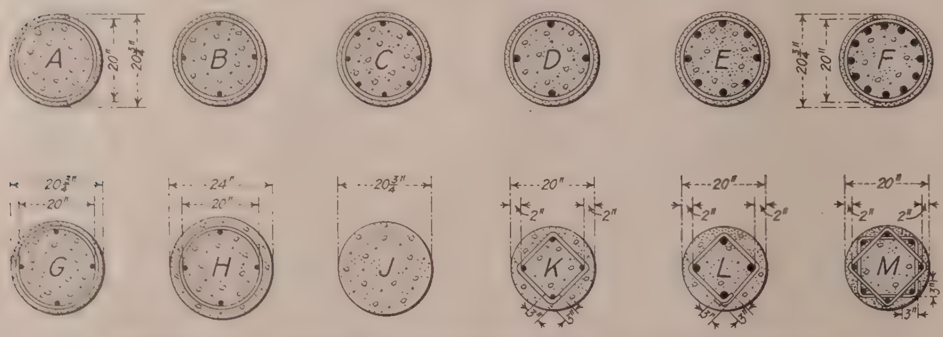
Characteristics of Failure

The two plain concrete columns (group 4) showed no cracks or other signs of failure until the maximum load was reached except that at 2190 lb. per square inch one column developed a small longitudinal crack just below the head. At the maximum load longitudinal cracks developed all around the shaft below the top of the head and extended down over the upper quarter of the length. The load at once fell off 20 per cent or more.

The columns having longitudinal but no spiral reinforcement (group 5) showed no marked sign of distress before the maximum load was reached. In some cases no crack was visible below the maximum load, and in others a minute crack was found at 85 or 90 per cent of the maximum load. Scaling of the longitudinal reinforcement at the gage holes was seen at loads below the maximum. In general the load fell off considerably a half-minute or so after the maximum load was reached. The diagrams on page 529 show the variation in strength with increase in steel.

The columns with spiral reinforcement acted as indicated by the typical strain diagrams, and during the early part of the tests the behavior was similar to that of the unhooped columns. Beyond the load which corresponds to the maximum load of an unhooped column the column shortened more rapidly with increase of load, the change in stiffness was very noticeable and the stress in the spiral increased very rapidly. The decreasing stiffness of the column was very marked and at loads near the maximum the ratio of the added load to the added longitudinal shortening was, for columns with 1 per cent of spiral steel, say, 1/15 of that found at loads below the maximum load of an unhooped column. As the maximum load was approached, the spiral stress was no longer uniform around the circumference, and it varied at different parts of the length of the column. Finally at some point the maximum strength of the spiral reinforcement was reached or the action of the column became very far from uniform, and the maximum load which the column would carry was attained.

Spalling occurred in one or more parts of the column—generally in several—either a little in advance of the maximum load or at the maximum load. The maximum load was held for some time, a minute or more, the pump operating during this time and the spiral reinforcement continuing to stretch. In many cases the spiral broke either at the maximum load, or at later and lower loads obtained by continuing to run the pump of the testing machine.



SECTIONS OF COLUMNS, SHOWING REINFORCEMENT AND INDEX LETTERS

Average Ultimate Strength as Affected by Reinforcement

Index letter	Number tested	Vertical steel: Per cent	Vertical steel: Description	Average strength, lb. per sq. in.: Columns	Average strength, lb. per sq. in.: 8 x 16-in. cylinder
Group 1—Vertical Steel Variable; 0.94 Per Cent ⅜-Inch Spiral Steel, 2¼-Inch Pitch, 4 Spacers					
A	3		None	4,850	2,945
B	3	0.91	4 bars 1-in. round	4,920	3,010
C	2	1.83	8 bars 1-in. round	4,915	2,880
D	1	1.89	4 bars 1 7/16-in. round	5,885	2,675
E	2	5.70	8 bars 1¾-in. round	5,965	2,880
F	1	5.71	12 bars 1 7/16-in. round	6,350	2,775
Group 2—Increase in Spiral Steel; 1.88 Per Cent ½-Inch Spiral Steel, 2-Inch Pitch, 4 Spacers					
G	2		Same as B	6,260	2,960
Group 3—Outside 2-Inch Shell; Otherwise Same as Columns B.					
H	2		Same as B	3,775	2,950
Group 4—Plain Concrete					
J	2		None	2,745	2,645
Group 5—No Spiral Steel; Variable Vertical Steel with ¼-Inch Ties 12 Inches on Centers					
K	2	0.98	4 bars 1-in. round	3,750	3,200
L	2	2.08	4 bars 1 7/16-in. round	3,690	3,255
M	2	4.07	8 bars 1 7/16-in. round	4,535	2,890

Effective Area of Hooped Columns

In discussing the properties of the hooped columns, the question at once arises as to what part of the cross-section of the column is affected by the restraint of the spiral and whether the whole section acts to resist the load imposed on the column. The section which gives the proper interpretation of the action of the column is wanted in this study, rather than the section which should be used in designing columns. Below the loads at which the spiral exerts an important effect the conditions are similar to those of an unhooped column, the full cross-section should be used, and a proper interpretation will involve the use of unit stresses calculated on this basis. For loads which give marked stresses in the spiral it is obvious that all or nearly all of the area within the spiral will be fully restrained. It seems evident that an area outside the spiral may be acted upon similarly, the restraint being carried by the shearing and tensile resistance of the concrete. For the columns in question the space entirely outside the spiral amounted generally to about ⅜ in., that is, a space equal to the diameter of the spiral reinforcement for the 1 per cent spirals. These columns showed no spalling up to nearly the maximum load.

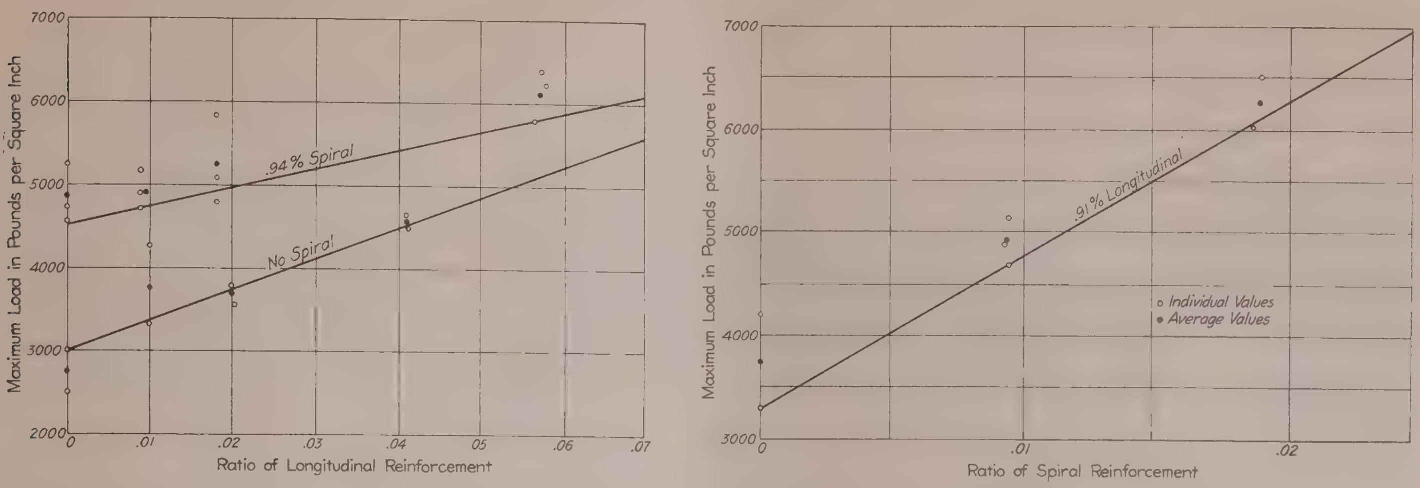
Calculations and diagrams made by using the core area only gave results which are inconsistent among themselves and not satisfactory in the interpretation of the data. The area of the gross section may be somewhat greater than the area effectively restrained, but it cannot be far from the right one. The unit stresses so found are smaller than would be obtained otherwise, and the variation from the real effective section will partly make up for the possibility of having used for the ultimate loads values somewhat greater than may be warranted by the plastic quality which occurs in a hooped column near its maximum load when the spiral has been stressed beyond its yield point. It seems best, therefore, to use the gross area of the cross-section of the hooped columns, and the average unit stresses given are so computed. This should not be taken to have a bearing on what section should be used in designing columns.

Formula for Ultimate Strenth

The lines drawn on the diagrams are plotted by the formula

$$f = 3000\ (1 - p) + 40{,}000\ p + 160{,}000\,(1 - 10p)\,q$$

where f is average unit stress over whole column section; p, ratio of longitudinal reinforcement to area of column section, and q, ratio of volume of spiral reinforcement to volume of column. This formula applies to columns without spiral steel, by making $q = 0$ so that the last term vanishes.



DIAGRAMS SHOWING VARIATION OF STRENGTH WITH VARYING PERCENTAGES OF BOTH VERTICAL AND SPIRAL STEEL

It may not apply to columns with 2 per cent spiral steel and variable longitudinal steel, as such a series of tests was not made. The formula is also limited by the range in the test variables.

In studying the results of the tests and the diagrams it may be well to take into consideration the area of the spacers as affecting the percentages of longitudinal reinforcement and the applicability of the formula. The area of these spacers was about 0.2 per cent of the column section.

The strength given by the spiral reinforcement is larger than has been found in other tests previously reported. In judging the results it should be borne in mind that these are short columns (less than six diameters between heads), that the spiral reinforcement was well made and properly placed, that the columns were straight and that the loads were applied in such a way as to produce little bending moment in the columns. It has been shown by tests that irregularity of pitch and inclination of spiral produce the same effect as crookedness and may reduce the column strength.

In the discussion above maximum loads are used and the values given are the ultimate strengths of the columns. A study of the load-stress diagrams made up from the data indicates that for any column the additional load due to the hooping is nearly proportonal to the stress in the spiral reinforcement. This holds up to a stress of say 85 per cent of the ultimate strength of the spiral reinforcement, when a marked variation in the stresses develops in different parts of a section. Rapid increase of stress at some point soon follows.

COLUMNS WITH FIREPROOFING LAYER

The two columns with a thickness of about 2 in. of concrete outside the spiral were tested to determine the action of the fireproofing layer or protective shell under high loads. The action of the column through the first part of the test was similar to that of an unhooped column. At the maximum load the longitudinal deformations were about those of an unhooped column at its maximum load, somewhat less than the usual amount at most points of measurement, but reaching the usual amount at others. Up to the maximum load no cracks or other signs of distress were visible.

At the maximum load the shell or layer outside the spiral rapidly cracked in various places in the upper portion of the column shaft, the load fell about 10 per cent and the fireproofing shell dropped off from this portion, either at the maximum load or a little later with a continued movement of the testing machine. With further movement of the head of the testing machine, and a corresponding shortening of the column, the load again increased and rose early to the original maximum load. During this time the spiral reinforcement in the exposed portion stretched as is usual with a hooped column, and the second maximum was that to be expected with a hooped column having a section corresponding to the outside diameter of the spiral.

It may be noted that the relation between the area of the gross section of a column having a given thickness of fireproofing, and the area of the section inclosed by the spiral, will depend on the size of the column. For these columns the load carried after the fireproofing layer failed was nearly as much as that which caused the failure of the outer shell. For larger columns (with the same thickness of fireproofing and the same percentage of reinforcement) the maximum load carried by a hooped column would be larger than the load which would produce failure of the fireproofing layer. For smaller columns the reverse would be true.

CONCLUSIONS

According to the committee, the results of these tests warrant the following conclusions:

1. Current practice seems confirmed as to the effect of varying percentages of longitudinal reinforcement within the range of the tests as expressed in the formula

$$f = f_c\,(1 - p) + n\,f_c\,p$$

2. Columns with spiral reinforcement appear to be stronger and tougher than columns with no spiral reinforcement.

3. Spiral reinforcement seems to be approximately four times as effective in giving ultimate strength to the column as the same volume of longitudinal reinforcement.

4. The effect of the longitudinal reinforcement decreases as the percentages of spiral reinforcement increases.

The making of the columns was inspected by A. S. Merrill, assistant to the chief engineer of the Turner Construction Company of New York City, and D. A. Abrams, of the University of Illinois Engineering Experiment Station. Especial acknowledgment is due to S. W. Stratton, director of the Bureau of Standards; P. H. Bates, in charge of the Pittsburgh laboratory, and J. H. Griffith, engineer-physicist; also to F. E. Foss, of Cooper Union, New York City, for laboratory facilities in making auxiliary tests. Prof. A. N. Talbot represented the committee, and W. A. Slater and H. F. Gonnerman, of the University of Illinois Engineering Experiment Station, supervised the preparation of the columns for the tests and were in direct charge of the testing operations.

Forest Service Suspension Bridges in Pacific Northwest

SEVEN suspension bridges involving rather difficult erection and transportation problems have recently been built across some of the deep gorges in the Northwest by the Forest Service rangers of Washington and Oregon. Two were erected in the Washington National Forest. One of these is over the Skagit River, connecting two abrupt perpendicular rock cliffs, and is about 84 ft. long between towers and 150 ft. above the water. The other, across Thunder Creek, about 96 ft. in span and 25 ft. above the water, is designed for a heavy snow load of 125 lb. per square foot. A notable illustration of the capabilities of the rangers is found in a bridge across the Wenatchee River, for which bids were asked from bridge construction companies. The lowest bid for construction alone was $3,266, which exceeded the funds available. Therefore the bridge was built by the rangers themselves at an approximate cost of only $2,700. It is 190 ft. long and 4½ ft. wide (for pack and saddle-horse use) and is made of 1½-in. crucible steel cables. Two bridges were built in the Rainier National Forest of Southern Washington, one of 180-ft. span with a total cable length of 373 ft., the other a foot and pony bridge of 150-ft. span. One of the two bridges erected in Oregon was situated 60 mi. up in the mountains, and was erected in severe winter weather, involving difficult and even dangerous work in packing the cables by horses over a narrow trail.

A GELATINOUS SUBSTANCE has been found to form below water line on piles driven along the line of the Key West extension of the Florida East Coast Railway. The substance is a marine growth, states Wm. J. Krome, constructing engineer for the railway, and is formed not only on piles but on concrete piers. On the latter he holds the coating to be of considerable value in preserving the concrete from the effects of salt-water deterioration and tidal erosion.

JOPLIN FLINT AND MINE SCREENINGS ARE USED FOR CONCRETE AGGREGATE

Five Years' Experience with Concrete Pavements at Fredonia, Kansas

Long Wear and Low Costs Are Advantages of Utilizing Joplin Flint and Mine Screenings for Aggregate in Small Town Work

A CONCRETE block pavement, utilizing Joplin flint and mine screenings for aggregate, which is said to wear well and the cost of which is low, has been obtained by Fredonia, Kan., as the result of 5 years' experimenting.

In the fall of 1910 the first concrete pavement was laid in an alley for one block. It was a two-course pavement having a 5-in. base of a 1:2:5 mixture on which was laid a 2-in. wearing surface, composed of 1 part cement to 3 parts Joplin flint and 1 part of sand. The pavement was cut into 12 x 20-ft. blocks by ½-in. expansion joints, filled with asphalt. Mechanically the work was far from perfect, as wooden templates were used, and it was impossible to withdraw them cleanly from the concrete due to swelling and warping. This pavement has been used by heavy drays since 1910 and to date has shown no sign of deterioration either from wear or weather, and not a single section has cracked or checked. The cost was $1.43 per square yard, including excavation, which amounted to 11 cents per square yard.

DEMAND FOR CHEAPER PAVING

So satisfactory was the first piece of work that five blocks of concrete block pavement were laid on residence streets in the spring of 1911. A demand was made, however, for a cheaper paving, and as a result the base was made 4½ in. thick and the wearing surface 1½ in. The wearing surface was made richer—1 part cement to 2 of aggregate—the amount of sand being varied as the Joplin flint ran fine or coarse. Steel templates ¼ in. thick, bent to the crown of the street and oiled, were used. The streets were 37 ft. wide and were divided longitudinally into three sections, the center division having an expanse of 13 ft. and the two flanking or gutter sections a breadth of 12 ft. each. Transverse joints were cut across the pavement at 12-ft. intervals. The cost was 21 cents lower than that of the 1910 work, the street being laid for $1.21 per yard, including excavation at 10 cents per square yard.

The width of the street necessitated the building of a movable bridge from curb to curb, from which men could work easily from any desired point. This was accomplished by means of a structure 3 ft. wide with heavy frame posts at the end strengthened by iron truss rods. The bridge was mounted on 4-in. iron wheels, which rolled in the gutter, and had a 12-in. siding in order to give the men a support to lean on while working. Half a dozen men were able to work on the bridge at a time.

Considerable trouble was experienced on the 1911 work from lack of cohesion between the base and wearing surface, and through cracking of sections. As the contractor had furnished a maintenance bond good for one year he repaired all defects that appeared within that time.

TRY RICHER BASE AND LEANER SURFACE

The following year, 1912, ten blocks of concrete pavement 30 ft. wide were laid. The sections were made approximately the same size as those laid the preceding year, but the mixture was changed, the base being made richer and the wearing surface leaner, with the hope of securing better cohesion. The base consisted of a 1:2:4 mix, and the wearing surface of 1 part cement to 2 parts of Joplin flint and 1 part sand. Using these mixtures the trouble from lack of cohesion was found to be entirely eliminated.

The pavement laid in 1912 was put down in dry, hot weather, and although the subgrade was wet and the surface sprinkled for two or three days after laying, the pavement checked considerably at the time and a good many cracks have since appeared. The total unit cost for the pavement was $1.08 per square yard, of which 9 cents was spent on grading.

No paving of any kind was done in Fredonia in 1913, but in 1914 twelve blocks of concrete were laid. In trying to meet a popular demand for a noiseless street at an extremely low cost, the wearing surface was reduced to 1 in., laid on a 5-in. base and covered with a squeegee coat of Tarvia A and sand. Fredonia's residence streets are subjected to light traffic and the wear is slight, which made those in charge feel safe in reducing the wearing surface. To date there has been no evidence of peeling. Expansion joints ⅝ in. thick were used along the gutters, but in an endeavor to avoid unequal settlement no other longitudinal joints were used. The pavement was laid for 95 cents per square yard and the grading cost 10 cents per square yard, bringing the total cost to $1.05.

A TYPICAL CONSTRUCTION SCENE ON THE PAVEMENT WORK AT FREDONIA

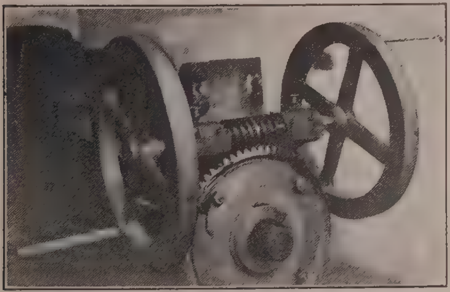
At the beginning of the 1914 work a census of conditions revealed the fact that 5 per cent of the sections laid up to that time had cracks running lengthwise of the street. There were no transverse cracks and nearly all of the longitudinal cracks occurred at a distance of 5 or 6 ft. from the gutter line, or else near the center of the section. In the work of 1911, where the pavement was made up of three sections in width, the central section was free from cracks. Although the rolling at the time seemed to be adequate, H. S. McFadden, city engineer, is of the opinion that the cracking was due largely to the settlement of the surface.

The cracking, while unsightly, has not led to further trouble; the cracks serve as expansion joints. A more serious condition is provided by unequal settlement in several places and by creeping of sections under contraction and expansion, leaving in a few places an expansion joint 1 to 2 in. wide. Some of these joints have been cleaned and refilled. It is estimated that all repairs now in view for the pavement laid from 1910 to 1912 can be made for about 1 per cent of the first cost.

The cost of sand and Joplin flints or mine screenings was 5½ per hundred weight at track, as compared with rock which costs $1.10 per cubic yard on the work. All pavement to date has been laid by C. W. Elliott, of the firm of Elliott & Vance, of Fredonia and Parsons, Kan., Mr. McFadden kindly furnishing the information from which this article was prepared.

Foolproof Device Prevents Breaking of Conduits

TO PREVENT too rapid opening or closing of a valve on one of the conduits in the water supply for the city of Denver, Colo., D. G. Thomas, chief engineer of the Denver Union Water Company, has devised a worm-gear attachment as shown in the photograph herewith. A 36-in. gate valve with outside screw and yoke is set on one of the two branch lines leading to the Platte Canyon and Marston Lake reservoirs respectively. There is a standpipe located on the line of the 2½-mile, 60-in. conduit supplying these branches, with its top 5 ft. above the hydraulic gradient within 1000 ft. of the valve on the Platte Canyon reservoir branch. It protects the line from the excessive pressure due to a too rapid slowing up of the water column from its normal velocity when the valve is closed too rapidly. The normal capacity of the 36-in. branch to the Platte Canyon reservoir is about 40,000,000 gal. daily, and when it is desired to diminish this amount to 15,000,000 or 20,000,000 gal. operation of the valve with this mechanism permits the water to back up to the intake elevation without any surging in the conduit or spilling at the standpipe.



WORM GEAR PREVENTS TOO RAPID OPENING OR CLOSING OF VALVE

The valve stem has a pitch of three threads per inch, and by the original 1:4 ratio of the bevel gears it requires only twelve turns to drop the valve 1 in. or about thirty minutes time for a complete shutdown. With the worm gear it requires 204 turns to move the valve 1 in. and the most enthusiastic attendant cannot close the valve completely in much less than two hours, thus assuring absolute safety to the conduit whenever it becomes necessary to diminish the flow through the line.

Literature

For the Civil Engineer and Contractor

New Publications

TUNNELING—SHORT AND LONG TUNNELS OF SMALL AND LARGE SECTION DRIVEN THROUGH HARD AND SOFT MATERIALS. By Eugene Lauchli, civil engineer. Cloth; 6 x 9 in.; 238 pages; illustrated. New York, McGraw-Hill Book Company, Inc. $3 net.

STREET PAVING AND MAINTENANCE IN EUROPEAN CITIES. Report by Henry Welles Durham, chief engineer of the Bureau of Highways, City of New York. Cloth; 7 x 10 in.; 437 pages; illustrated; maps and diagrams. New York, Office of the President, Borough of Manhattan.

ENGINEERING ECONOMICS—FIRST PRINCIPLES. By John Charles Lounsburg Fish, professor of railroad engineering, Leland Stanford Junior University; author of "Earthwork Haul and Overhaul," etc. Cloth; 6 x 9 in.; 217 pages; tables and diagrams. New York, McGraw-Hill Book Company, Inc. $2 net.

LOCAL IMPROVEMENT BY SPECIAL ASSESSMENT IN ILLINOIS—Outlines of Procedure and Forms. By Royal B. Cushing, of Knapp & Campbell. Paper; 6 x 9 in.; 48 pages. Chicago, Universal Portland Cement Company.

An abstract of the law of special assessments in Illinois, and guide to particular statutes and cases concerning the construction of local improvements in city, town or village. The best methods of procedure are outlined, and standard forms for petitions, resolutions, ordinances, etc., are given. References are made to sections of the Local Improvement Act and to a few Supreme Court decisions.

REPORT OF THE CHICAGO COMMISSION ON VENTILATION. Paper; 6 x 9 in.; 99 pages; illustrated; 25 cents.

This is the first report of the commission organized in 1910. The organizations represented are the Health Department, Board of Education, Illinois chapters of the American Society of Heating and Ventilating Engineers and of the American Institute of Architects, Illinois Society of Architects and Western Society of Engineers. The report contains statements of the methods and working principles of the commission; reports of tests made on ventilation of cars, picture theatres, an experimental school room, an office and an experimental cabinet; sixty-eight opinions of the commission on phases of ventilation, and descriptions of the apparatus used in the tests.

Books Reviewed

Sewage Purification and Disposal

Author, G. Bertram Kershaw, engineer to the Royal Commission on Sewage Disposal. Cloth, 5½ x 9 in.; 340 pages; 56 illustrations. Cambridge, University Press. $1.50 net.

Reviewed by George A. Johnson

Consulting Engineer, New York City

This book was published by the Cambridge (England) University Press as one of the "Cambridge Public Health Series," and while the subject matter applies essentially to sewage-disposal practices in Great Britain, and in England in particular, the author takes frequent side trips to America for data, drawing liberally therefor from Fuller's "Sewage Disposal" and the Reports of the Massachusetts State Board of Health. The author has brought together in concise form and in a thoroughly readable manner a large share of the more recent information on the important subject of sewage treatment. He does not touch upon disposal by dilution, explaining that this aspect of the problem is being dealt with by Dr. W. E. Adeney in a separate volume of the Cambridge Public Health Series.

In the earlier chapters—there are ten in all—the author discusses conservancy methods, composition of sewages, sewerage systems, variations in sewage flow, storm water, etc. There is an instructive chapter on the removal of suspended matter from sewage, and methods of sludge disposal are described at considerable length. In the chapter on sludge disposal frequent reference is made to Kenneth Allen's book on "Sewage Sludge." Purification by land treatment and in contact beds and sprinkling filters is well covered in a comparatively few pages. In the chapter on sewage sterilization the author takes a very rational and sensible position. The chapter on the treatment of trade wastes is all too short.

There are instructive tables on practicable rates of treatment of sewage which has undergone various preparatory treatments, and on the cost of certain operating procedures.

The book is unusually well indexed, and a bibliography given at the end of each chapter furnishes a valuable feature.

Design of Steel Bridges

Author, F. C. Kunz, formerly designer for the bridge and construction department of the Pennsylvania Iron Works and the American Bridge Company. Cloth, 6 x 9 in.; 472 pages; 52 plates. New York, McGraw-Hill Book Company, Inc. $5 net.

Reviewed by F. H. Constant

Professor of Civil Engineering, Princeton University, Princeton, N. J.

There are a number of excellent textbooks completely covering the field of stress calculation, algebraic and graphic, in structures, but there has been an urgent and growing need for an up-to-date treatise on the practical side of designing, written for the practising engineer and the advanced student. The present work very adequately fills that want. It is written by an engineer of many years' professional practice, and embodies valuable data, practical rules, tables, drawings, etc., drawn from his store of experience. The author states that the present volume is the first of four, each to be complete in itself. "It aims to give the bridge engineer numerical examples and results of the best modern practice in designing and estimating of steel bridges, and to serve him as a guide and aid in the calculation of stresses, sections, weights, etc." The text, itself a volume of 472 pages, is followed by 52 folding plates, many of which are complete in themselves and are "expected to guide the designer from the dead and live load assumptions to the last rivet spacing without reference to the text."

The first six chapters deal with external forces and stresses in beams and simple trusses. Chapter 1 contains many valuable tables and data, covering dead and live loading and all of the other forces which may affect a bridge. Chapter 2 is general about reaction and influence lines. Chapter 3 covers moments and shears in simple spans. Methods of influence lines have been developed in this and succeeding chapters at considerable length. Many tables are inserted which give at once maximum moments, shears, floorbeam reactions, equivalent uniform loads, governing wheels in girders with and without floorbeams, and in trusses of from 4 to 10 panels and panel lengths varying from 8 to 35 ft. Likewise there are tables of maximum moments and shears for nine different types of electric cars or trains for spans up to 80 ft. Chapters 4 and 5 on stresses in simple trusses and in the lateral bracing of same are a clear and simple exposition of the subject, and would form an excellent text for classroom purposes. Chapter 6 is definitive, dealing with types and classifications of bridges and principal parts and general data. It discusses economic span lengths, heights, clearances and cross-sections for bridges.

Chapter 7 discusses the design of floors for railway and highway bridges. Chapter 8 covers beam and plate-girder bridges in a simple, practical and sufficiently comprehensive way. Valuable tables are inserted, giving centers of gravity of girder flanges for a considerable range of the larger angles and cover plates; types of girder flanges from 11.5 to 148 sq. in., and the complete design, stresses and estimate of weight and material of standard single-track deck girders, Cooper E50, for all spans varying by 10 ft. from 30 to 110 ft.

Chapter 9 in similar manner deals with simple truss bridges, discussing form and design and the proportioning of parts. Tables of typical chord sections with areas ranging from 8 to 500 sq. in. are given, as well as many of the useful tables found in the handbooks. Pin packing, the calculation of moments of shears on pins, the design of the latticing of columns by an approximate rational theory, and camber are successively given brief treatment. Chapter 10 on skew bridges and bridges on curves is of special interest in developing the formulas, determining the required width of through truss spans on curves, based on required clearance and the extreme dimensions of the car. Chapter 11, giving weights of bridges by formulas, diagrams and many tables, is of special value to the practical designer. It includes actual detailed steel weights of a number of existing bridges.

Chapter 12 on viaducts deals at some length with stress analysis and design, giving economical span lengths, batter of columns, bracing, column sectioning and weights. Chapter 13 discusses elevated railroads rather briefly, and chapter 14 treats of movable bridges and turntables, largely from a general and stress analysis point of view. Operating power and motors receive very inadequate mention, and the reviewer hopes that the author will develop this important subject in one of the contemplated succeeding volumes.

Chaper 15 (54 pages) on arch bridges includes first a concise but excellent treatment of the theory of the three-hinged and two-hinged arches, mainly by the influence-line method. The various simplified approximate methods of calculating the horizontal reactions of a two-hinged arch, depending on the shape of the arch and the degree of accuracy desired, serve for the preliminary calculations and even in some cases for the final. The analysis of stresses due to wind and braking forces is concise and complete. As an example, the stresses of a 250-ft. two-hinged spandrel-braced arch, Cooper E50, are found by influence lines and the tabular method. This chapter also includes the practical design of arches and a brief description and principal data of a number of the most important existing arches.

Chapter 16, in similar manner, discusses long-span bridges in general, and gives examples of the leading cantilever and suspension bridges with their most important data. Chapter 17 covers cantilever bridges in a manner similar to the treatment of the arch. Each of the last six chapters contains a selected reference list taken from American and European periodicals and reports.

In addition to the folded plates already mentioned, which are referred to constantly throughout the text, there are eight appendices, giving actual pressures in foundations of bridges and buildings, the physical properties of metals, many tables of use to the designer, and the specifications of the American Railway Engineering Association for steel railway bridges.

The book is clearly and concisely written, and out of the mass of theory and detail which characterizes the structural field the author has selected with discriminating care. It is a closely knit work, essentially a treatise, intended to meet the needs of the mature practising engineer, and in this respect it amply fulfils its purpose. At the same time it may prove of service in the classroom as a work of reference for advanced students, supplementing the more elementary instruction in stresses. The typographical work is uniformly excellent and pleasing. The volume is a distinctly notable and welcome addition in the field of structural literature.

Centrifugal Pumps

Author, R. L. Daugherty, assistant professor of hydraulics, Sibley College, Cornell University. Cloth, 6 x 9 in.; 192 pages, 111 illustrations. New York, McGraw-Hill Book Company. $2 net.

Reviewed by A. G. Hillberg

Wegmann & Hillberg, Hydraulic Engineers, New York

This book seems to have been written primarily to serve the needs of the practising engineer, but through the insertion of numerous problems it has also been made suitable as a text-book in engineering colleges. It is, however, not extensive enough to be a book on centrifugal pump design, though prospective designers will benefit by the study of the subject as treated.

The author has subdivided the subject into fourteen chapters and three appendices, illustrating and explaining the essential features of construction of modern centrifugal pumps, their general theory and operation. The chapters dealing with factors affecting efficiency, comparison of types and pump testing are brief, but contain, nevertheless, all information of importance on those subjects. The chapter entitled "Costs" has two very handy diagrams, from which the cost of stock centrifugal pumps can be obtained as soon as their required capacities in gallons per minute have been determined. It also deals with the cost of pumping and gives formulas by which the total annual cost of pumping for steam-driven and motor-driven pumps can be quickly and accurately calculated.

Appendix A gives test data; Appendix B, review questions, and Appendix C, a table of ¾ powers of numbers ranging from 1 to 300.

Judged as a whole, the author has treated the subject well. It is hoped that in future editions the author will expand the chapters on theory and add one on design, thus giving the book a broader scope.

Art of Estimating the Cost of Work

Author, William B. Ferguson, naval constructor, U. S. N., cloth, 5 x 8 in.; 97 pages. New York, The Engineering Magazine Company. $1.

This is a very thorough and conscientious effort to suggest some method of systematizing the keeping of costs on a most variable branch of construction. The author seeks to suggest a means by which the costs of repairs and alterations to ships may be ascertained with a reasonable degree of accuracy, and, by using this information as a basis, to indicate methods of scientific estimating and of increasing the efficiency of the individual workman. Although the examples given are entirely of work done in ship yards, there is much in the book that is worthy of the study of the civil engineer and contractor, not so much for the sake of the particular classes of work cited, but on account of the suggestions that the reader might adapt and apply to his own line of work.

A note that accompanies the present edition explains the difficulties under which it was produced and gives promise that future editions will be more attractively gotten up, so it seems almost unkind to point out the mechanical defects that exist in the volume. But they do exist, and so flagrantly as to make a concentrated reading of it almost impossible. The paper is of such a quality and the printing so poor as to make it impossible to read more than a very few pages without becoming eye weary, and it seems that it would have been wiser had the publishers withheld distribution until they could have improved the appearance of the entire volume. Modern readers insist upon attractive presentation and have been educated to a proper appreciation of the value of their eyesight.

COMPARATIVE TESTS recently made at Columbia University to determine the relative value of "Palisade" trap rock and of "National" slag as large aggregate for concrete resulted in favor of the slag concrete by an average increase in strength of standard compression cylinders of about 18 per cent. The trap rock was screened and artificially combined to give a graded mixture exactly similar to the slag furnished by the National Slag Company. A standard 1:2:4 mixture was used, and to insure exactness the large aggregate was carefully weighed. The cement was a mixture of three standard brands of Portland cement approved by the New York Building Bureau, and the sand a typical Long Island variety. Four standard 8-in. cylinders of each aggregate were made and tested at the age of three months. The average ultimate strength of the trap-rock concrete was 2960 lb. per square inch and of the slag concrete 3500. One low value resulted in each case—2460 for the rock concrete and 2955 for the slag concrete. The trap rock weighed 100 lb. per cubic foot and the slag 80 lb. The tests were conducted by Harold Perrine at the Columbia University Laboratory.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

Unit for Maintenance Cost

SIR: The first editorial, "Unit for Maintenance Cost," on page 416 of your issue of April 3, has attracted my attention. The first sentence is unquestionably correct, but its truth still needs some diffusion. Are you sure that your second sentence, especially the first portion of it [that the ton-mileage system offers a correct basis] is correct? It seems to me that it is not, because the "ton-mileage" system, so interestingly referred to in the article on page 418 of the same issue, does not give consideration to the speed and tire factors of so much importance in many cases.

Knowing the esteem with which your editorial statements are regarded, I take the liberty of inviting your attention to the dangers that may be created by the publication of a statement by you editorially that "the ton-mileage system offers a correct basis in figuring maintenance costs," and of saying that it seems to me you can not afford to let this statement stand without some qualification.

W. W. CROSBY.

Baltimore.

Largest Hydroelectric Units

SIR: We notice in your issue of March 20, page 377, a small paragraph referring to the largest hydroelectric plant installed. The 20,000-hp. units mentioned in this article are not the largest hydroelectric units in the world, as stated by you. We have two units installed at Big Creek No. 1 power house at the Pacific Light & Power Corporation, where they are developing power in excess of 22,000 hp. each. The official test of this plant was made December, 1913, and showed a maximum horsepower of 22,704 brake hp. under an effective head of 2019.3 ft. at 375 r.p.m., and this output is frequently obtained from the units during the peak loads of the system of the Pacific Light & Power Corporation.

ALLIS-CHALMERS MANUFACTURING COMPANY,
By Wm. P. Harper, Manager of Purchases.
Milwaukee.

A New Adhesive for Holding Field-Instrument Cross Hairs

SIR: It may be of interest to some of the readers of the Engineering Record to know of a new substitute for the regular adhesives used for putting field-instrument cross hairs on to the diaphragm. The writer was in camp when the levelman came in from the field with both the level cross hairs gone, and as this was an unexpected accident it was found there was no glue or wax anywhere on the job. I happened to remember having in the medicine kit a small bottle of "New-Skin," or liquid court plaster, and the experiment was tried with great success, the preparation being waterproof. It has been in the level now about two years, and is still in first-class condition.

In using it, the main point to be guarded against is not to apply it until the hair is in exact position, as it dries most quickly upon exposure to the air. It is presumed that other similar preparations under various names will serve equally well.

L. W. DUFFEE, C.E.

Mobile, Ala.

Report of a Licensed Architect

SIR: Apropos of the licensing of engineers and architects and the voluminous discussion as to the desirability and value of such legislation, I send the following report made by a "licensed architect" upon a reinforced-concrete design which was questioned by the council of a small city. The structure in question was a viaduct of girder and slab construction.

"I have carefully examined the plans of ———— and find as follows:

"All measurements are practically correct.

"All concrete abundantly strong.

"But the iron is not heavy enough or strong enough, to wit, in the spans, 34 ft. 7½ in., the load per single girder is

Concrete at 135 lb. per cubic foot floor	18.697
Girder, at 135 lb. per cubic foot	15,581
Iron, at 135 lb. per cubic foot	0.845
Load, at 100 lb. per square foot	20.775
Total	55.809
Strength of iron or steel, at 16.000 lb. per square inch	101.315
Strain on steel to carry the above load	167.427

"The total area of steel in girder is 6.3322 and it should be 10.4642 in. in each of the three center girders now to illustrate take an I beam weighing 100 lb. concontaining 29.41 sq. in. 24 in. in height and a span of 28 ft. will carry a load of 59.620 now in the I beam we find that 18.41 sq. in. is in neutral and crushing strain leaving 11 in. in tensile strain (according to the tables) now a concrete beam or girder is in proportion to and in principle the same, except concrete is used for the neutral and crushing part of said beam and the steel for the tensile strain thus it will be plainly seen that the concrete girders should have the amount as above stated and following the entire structure through I find about the same proportions."

(Signed) ————————,
Architect.

(Seal)
(Licensed Architect.)

As the report has been followed closely in the matter of grammar, and so on, it could hardly classify as a model.

It is seen that the writer nonchalantly, after stating the facts in the case, dismisses the subject in one sentence of 138 words and two commas. His method of analyzing the stresses in a reinforced-concrete girder, 16 x 30 in., in section with a span of 34 ft. 7½ in., by comparison with an I-beam "weighing 100 lb. containing 29.41 sq. in. 24 in height and a span of 28 ft." is rather novel, to say the least. Whether or not the report is worth the $40 the city paid for it is an open question. In justice to the architectural profession, it must be stated that the architect in question was not practising at the time the report was rendered.

In view of the foregoing, does the licensing of architects and engineers protect the public as it is supposed to do? In these days of reinforced concrete in the architectural field the requirements for a license should at least be made more stringent. It would appear that the classical distinctions between C. E. and S. I. and architect and arch-i-teck still avail, in spite of the licensing laws.

ENGINEER.

Facilitating Timber Design

SIR: Referring to the article on "Facilitating Timber Design" by Sidney Diamant, in your issue of March 6, the formula given for flitch plate girders on page 297 is simply the equating of the bending moment for a uniform load with the moment of resistance of the section, and K, the handbook constant, is the resultant fiber strain, or

$$K = (11/12)\ 1800 + (1/12)\ 16{,}000 = 2983\tfrac{1}{3}$$

Using a fiber strain of 1500 for wood,

$$K = (11/12)\ 1500 + (1/12)\ 16{,}000 = 2708\tfrac{1}{3}$$

instead of 2500 as given. With the value of 2500 for K, the fiber strains would be a little less than 1400 for wood and 15,000 for steel.

The principal point, however, is that the formula given is based on a metal proportion of one-twelfth, obtained from the old values of the moduli of elasticity, 26,000,000 for wrought iron and 2,000,000 for hard pine, and is incorrect for any other values. For the values of 29,000,000 for steel and 1,500,000 for Oregon fir, the proportion of metal is one-eighteenth that of wood, and not one-twelfth. Then for the fiber strains assumed

$$K = (17/18)\ 1500 + (1/18)\ 16{,}000 = 2305\ 5/9$$

instead of 2500. The fiber strains developed by using a value of 2500 for K are 1630 for fir and 17,390 for steel, in place of 1500 and 16,000, as given.

F. A. SHERRILL,
Structural Engineer.

Denver.

[In checking the figures given in this letter, it was noted that the formula at the top of the third column on page 297 should contain D^2 instead of D, and should read

$$W = (8BD^2/6L)\ K$$

instead of as given.—EDITOR.]

THE MASSACHUSETTS HIGHWAY COMMISSION, during the year ending Nov. 30, 1914, completed construction on 76 miles of State routes. Construction was begun, but not finished, on 25 miles and layouts were made for 59 miles of State highway. The total length of improved State highways at the end of the year was 1039.07 miles. The commission continued its policy of building roads 18 ft. wide in preference to the old 15-ft. widths. Of the work done last year 35¾ miles were bituminous macadam; 4¾ miles waterbound macadam to be coated with a bituminous binder; 3⅛ miles gravel road; 5½ miles sand bound with heavy asphaltic oil; 9 miles macadam with hot asphaltic oil; 3 1/5 miles bituminous gravel; 2¼ miles concrete; 2½ miles sand and clay. The remaining work consisted of graded road. There were no changes in the administration of the work; in fact, 24 of the engineers in the more important positions have been with the commission over 10 years. Col. W. D. Sohier continued as chairman of the commission, and Arthur W. Dean as chief engineer.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

[*Contributions to this section are solicited, and if found available will be paid for. They must be* SHORT, *and should be accompanied, if possible, by photographs or sketches.*—EDITOR.]

Slotted Pipe Aids Placing of Hydraulic Fill

By A. M. THOMPSON

Engineer, La Crosse Dredging Company, Minneapolis, Minn.

SLIP-JOINT pipe of No. 14 gage steel in 25-ft. sections and provided with slots which could be closed at will were used with success in 1913 to construct 20,000 ft. of levee in the Henderson County drainage district along the Mississippi River in Iowa. That material which was heaviest and best able to resist errosion, of course, came out of the first slot left open, and was spread over the crown and sides of the levee, while the finer material was carried on to the end of the line and formed a closely compacted core for the levee.

SLOTTED PIPE DISTRIBUTES HEAVY MATERIAL ON TOP, FINE IN CORE

Steel plates at sides used to build up desired slope of levee banks

The site of this levee was first cleared and ploughed. The material, which was mostly sand, was pumped from the river by a 12-in. centrifugal of 200 hp mounted on a dredge boat. The pipe line was suspended with its bottom at the grade of the top of the levee. The sections, which were easily handled by four men each, were slung with manila rope from A-frames made of poles cut on the levee site. In some places the levee fill was 22 ft. high.

To prevent the material from spreading too much, No. 14 gage steel plates 18 in. wide and 10 ft. long are used, as illustrated in the accompanying photograph. To one end of each plate is riveted a 9-ft. length of 1¾-in T-bar. The sections are overlapped a few inches and the T-bars driven into the fill to hold them in place. They are moved up as the filling progresses, being put at the intersection of the desired levee slope with the slope being taken by the material as it flows from beneath the pipe. By their use it is not difficult to maintain an accurate side slope.

In handling the pipe sections, the levee is allowed to fill up to within 30 or 40 ft. of the end of the discharge line. The pump is then shut down, the slotted pipe sections on top of the finished levee removed and replaced with solid sections, and the end of the line extended. Pumping then proceeds. About 1200 cu. yd. per shift was placed in this way over 30-day periods. No allowance, of course, had to be made for shrinkage of material in place.

Placing material in this way has been found more expensive than building levees by some dry-fill methods. This construction, however, has withstood severe floods in several sections without requiring repairs. Other advantages, including freedom from settlement both of the levee and of the ground on which it is made, are causing this type of construction to come into more general use in the West.

Suggestions for Concreting Street Railway Track

By S. GAUSMANN

Formerly Roadmaster of Surface Lines, Brooklyn Rapid Transit Company

IN the concreting of modern street railway track construction steam cinders make a good, cheap concrete with a 1:3:6 mix but it is too often necessary to use more sand and cement, reducing the proportions to 1:2:4, on account of the quality of the cinders. Unless these cinders are obtained free, the cost of the concrete will be nearly as much as if gravel or stone is used and yet it will be inferior in quality to mixtures containing the latter elements. A 1:3:6 mixture containing either stone or washed gravel, preferably the latter, is most desirable in modern track construction.

One of the causes of failures in paving is that when the concrete is placed in the track it is often too wet, thereby undermining the bed of the ties and causing the track to "pump." Concrete with an excess of water should be avoided, especially where operation is resumed over track immediately after the concreting is finished and before it has had time to set.

Another condition to be avoided is the failure to compact the concrete thoroughly under the rail. While with an exceedingly wet concrete this space will be filled at first, the concrete will soon shrink away from the rail, leaving a void which is not large in extent, but large enough to do damage. On the other hand, when the concrete is of the proper consistency a large pocket will be left unless extreme care is used. To avoid this trouble the concrete should be thoroughly placed by shovel tamping, followed, after it has set slightly, by tamping with tamping bars from both sides of rail. Unless this is done sand from below the paving will work into the pockets and cause the pavement to settle, especially along the rail.

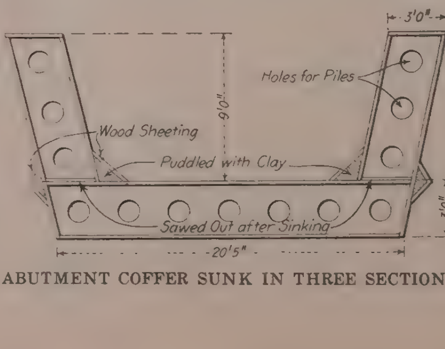
When track is concreted from the bottom of the ties to 3 in. or more above the ties it is advisable to do so in two sections, bringing the first section to the top of the ties, and placing on this a very thin layer of sand, followed by the rest of the concrete. While this separation may seem to be added work it can be done at no greater expense than if the concrete was placed all at once; it will not injure the quality of the foundation, and although the "other fellow" possibly is not considered the two-section practice means much good to the road when reconstruction is undertaken.

Wood Cofferdams with Bottoms Sunk for Bridge in Swamp

By C. E. JONES

Minneapolis, Minn.

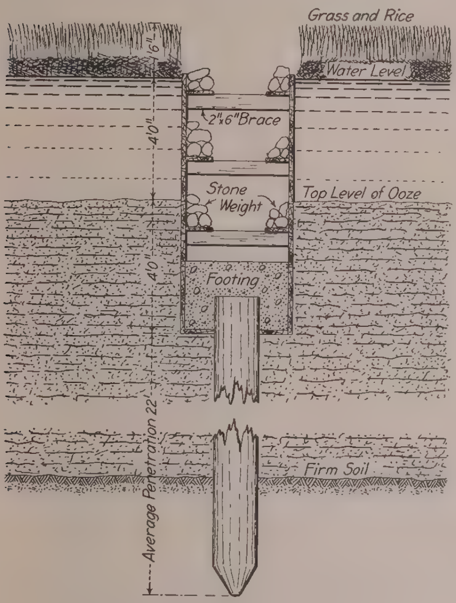
BOXES with calked bottoms, having holes through which piles were driven, were used in building a concrete bridge abutment in the middle of a swamp 25 miles from a railroad in Clearwater County, Minn. The mat of vegetation which covered the water in this swamp prevented the use of floating equipment, and the fill and wooden approaches to the old highway bridge furnished the only secure footing available for land equipment. Several feet of water covered the site of the bridge. An ordinary bottomless cofferdam would have been useless, as the deep ooze forming the lake floor was too unstable to allow pumping such a structure.



ABUTMENT COFFER SUNK IN THREE SECTIONS

The old bridge floor was removed, and a chunk of vegetation over each abutment was hacked out with cross-cut saws and hay knives. Three boxes for each abutment were built on plank platforms laid on the floating grass mat. Holes were cut in the bottoms of these boxes through which piles could be driven. Each hole was cut to fit, with ½-in. clearance, a particular pile, which was marked for that location.

The boxes were launched, held in place with timber guides and weighted with stone, the two larger ones taking 5 cu. yd. each. They were then sunk 4 ft. into the mud by churning the ooze into them through the holes in the bottoms with long poles fitted with dashers. A 10-ton jack set under the old bridge helped to weight the larger boxes. It took about an hour to sink a box half a foot in this way, with four men churning and two spading along the outside of the box with hoes. When the boxes were at grade, a light driver was set up and the piles driven. These piles dropped 18 ft. of their own weight, but came to a satisfactory bearing about 30 ft. below water level.



COFFERDAM BOX WITH BOTTOM SUNK IN SOFT MUD

Cleats across the top of the boxes had to be spiked to the piles to hold the boxes down during pumping. After the boxes had been pumped out and the ooze bailed out with buckets, these cleats were replaced by others at the bottom of the box. Sheeting was driven where the wing boxes joined the main box, and the space inside puddled with clay. The ends of the wing boxes and two sections of the back side of the main box were then sawed out without difficulty, making a continuous U-shaped cofferdam which served as a form for the abutment concrete. Slight leaks around the piles were readily stopped by a little calking.

The bridge was a concrete slab, reinforced with I-beams of 23-ft. span and carrying an 18-ft. gravel roadway. With the live loads assumed, each pile had to support 10 tons. The bridge was designed by the Minnesota State Highway Department. It was built by the writer, as superintendent for the contractor, at a profit, by the use of these methods, in spite of its unfavorable location.

Keeping Accurate Daily and Total Cost Sheets Will Pay the Contractor

Firms Engaged in Paving and Road Work Can Cheapen Jobs Under Way and Make More Profitable Bids by Close Attention to Cost Reports

By C. B. MONTGOMERY
Union Paving Company, Philadelphia

RELIABLE cost data serve two purposes for the paving contractor. First, immediate reports while the work is going on disclose leaks and inefficiencies that can be remedied with profit on the spot. Second, complete and accurately kept costs for one job furnish a basis for bidding rationally on the next one of a similar kind. This advantage is most pronounced in paving work, where similar conditions are met with again and again in the business of the same firm. It is also one which is too little realized, and seldom made use of by the average firm. A contractor will often merely ascertain the local prices of materials, estimate the labor requirements, add the conventional 20 per cent for overhead and then affix an item for profit determined largely by the amount of competition and the state of his exchequer.

VALUE OF DAILY REPORTS

Often a contractor will make or lose large sums without knowing where or why it occurred, and without giving a thought to what changes are needed under the same conditions on another job. Each day's work should be summarized, showing the labor and material costs and the contract value of the day's work done. This summary should be placed in the superintendent's or manager's hands within twenty-four hours. Thus leaks can be located at once and steps taken to remedy them. It is useless to censure a foreman after a job is completed for extravagances upon it, while, on the other hand, a timely pointer may often mean better results from the working force or a more economical use of materials.

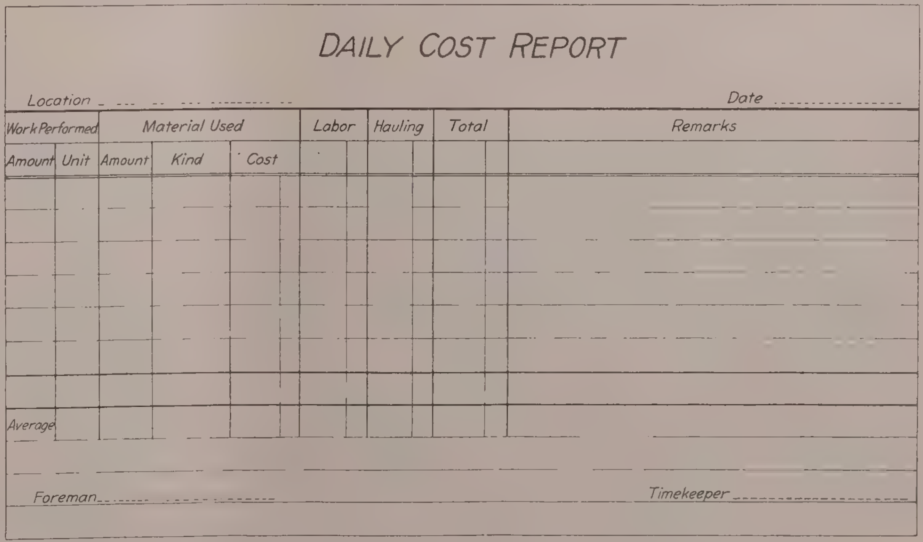
The short form given herewith is a suitable means of achieving the object of these daily reports. A report such as this must be the foundation of any system, however elaborate. It shows all work performed each day, the total cost thereof and the average unit cost.

The long form fulfils the second object of the system. Upon this sheet is posted the information given on the short form, together with all other information regarding this particular job. Posting may be done daily, but weekly posting is recommended, as it greatly reduces the amount of clerical labor. This minimizes errors and thereby increases the value of the cost sheet. At the end of each week or pay period the total labor amount posted should be checked with the payroll for that period. In a similar manner all materials should be checked with the invoices received.

For preserving these reports, the short form may be filed in a letter file under the foreman's name, keeping the latest dates on top. The long forms may be conveniently bound in a loose-leaf binder, the names of the streets or jobs being in alphabetical order. When a job is completed the sheets can be transferred to a permanent file.

The subject of overhead expense is so complex and extensive that it will be impossible to discuss it more than briefly. It is of great importance, however, and should be included in any complete cost report. The common items constituting overhead are rent, light, heat, insurance, officers' salaries, tools and equipment, interest and discounts, office stationery, etc. The usual method of distributing overhead to the contracts performed is the inaccurate one of totaling the entire cost of a year's work, totaling the overhead for that year, and proportioning the latter evenly over the work. This method is not only loose, but requires waiting until the end of a year to get the complete cost. A modification of it, however, may be made to give much quicker and better results.

All overhead charges should be grouped under subheads, such as office expenses, which should include the clerical force, stationery, telephones, rent, etc.; tools; machinery, including steam shovels, concrete mixers, rollers, etc.; plant, counting such charges as rent, insurance, plant machinery, etc. (this item applying particu-



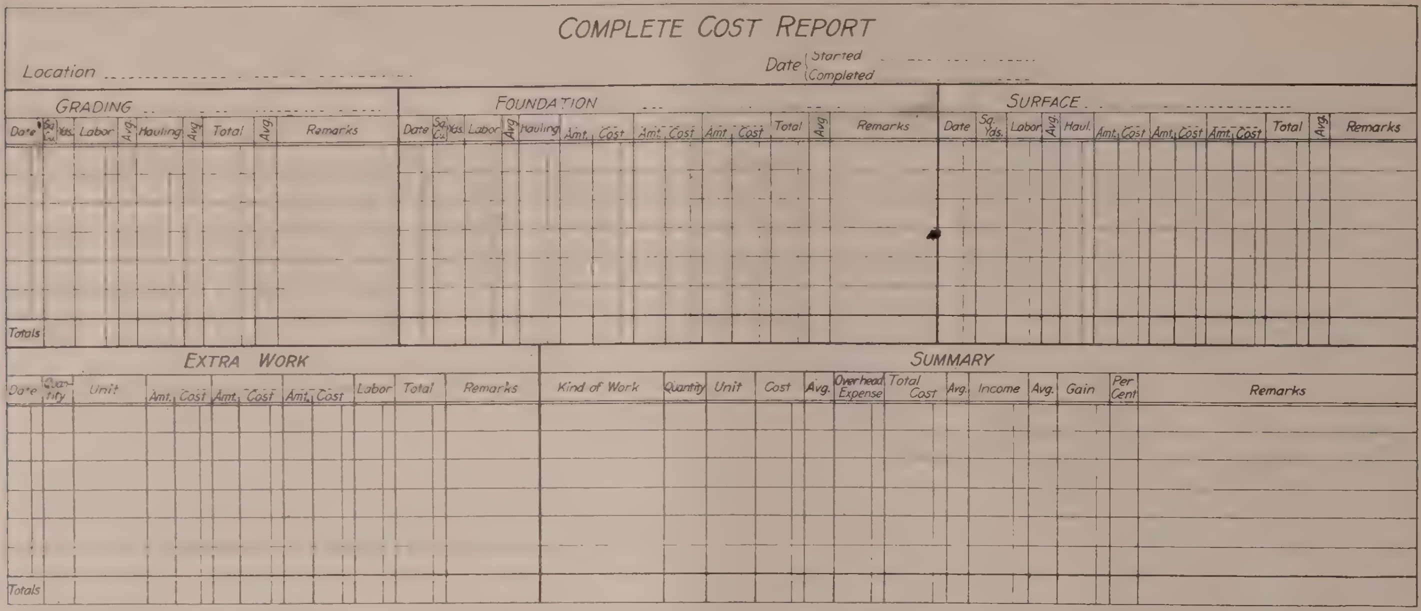
DAILY COST REPORT

Location .... Date ....

Work Performed		Material Used			Labor	Hauling	Total	Remarks
Amount	Unit	Amount	Kind	Cost				
Average								

Foreman .... Timekeeper ....

DAILY COST REPORTS SHOULD REACH THE CONTRACTOR WITHIN 24 HOURS



COMPLETE COST REPORT

Location ....

Date { Started .... Completed ....

GRADING ....

Date	Sq. Cu. Yds.	Labor	Avg.	Hauling	Avg.	Total	Avg.	Remarks
Totals								

FOUNDATION ....

Date	Sq. Cu. Yds.	Labor	Avg.	Hauling	Amt.	Cost	Amt.	Cost	Amt.	Cost	Total	Avg.	Remarks

SURFACE ....

Date	Sq. Yds.	Labor	Avg.	Haul.	Amt.	Cost	Amt.	Cost	Amt.	Cost	Total	Avg.	Remarks

EXTRA WORK

Date	Quantity	Unit	Amt.	Cost	Amt.	Cost	Amt.	Cost	Labor	Total	Remarks
Totals											

SUMMARY

Kind of Work	Quantity	Unit	Cost	Avg.	Overhead Expense	Total Cost	Avg.	Income	Avg.	Gain	Per Cent	Remarks

DAILY COSTS SHOULD BE POSTED WEEKLY ON THIS FORM AND CHECKED WITH PAYROLLS AND INVOICES FOR MATERIAL

larly to asphalt paving concerns who maintain expensive plants); general expenses, covering officers' salaries, interest and discounts, bad debts, etc.; and any other subheads which may be necessary. Of these subheads, all but plant and machinery should be handled alike and can therefore be lumped and treated as one. The total of these subheads should be distributed over the work for the year in this manner. The total labor cost of all work for a year should be taken as a basis for pro-rating the overhead. The amount or cost of materials used is not a factor in distributing any kind of overhead expense.

Expenses under the subhead plant are distributed only on the jobs which have received material from the plant. In the case of asphalt paving, the unit of production is the "box." The plant expenses for a year are divided by the number of boxes produced for that time and charged to the jobs where the material was delivered, in proportion to the quantities received by each. Machinery should, of course, be charged only to the work upon which it was used. The basis of division should be the number of days the machinery was in use.

It is desirable, as previously stated, to affix overhead charges immediately on completion of a piece of work, rather than to wait until the close of the fiscal year to determine the correct percentage. This should be done by using the percentages of the previous year. If, as is usually the case, conditions have changed, either by an increase or decrease in the volume of work done, or by an increase or decrease of overhead charges, the use of a previous year's percentage would result in a false showing which is not apparent until the close of a year's work. This difficulty is obviated by the method developed by the writer, of totaling and comparing the month's figures with the corresponding month of the previous year.

At the close of each month the figures for that month, both overhead and labor, are compared with the corresponding month of the previous year. The differences are added to or subtracted from the past year's totals. From these new totals a new percentage is obtained, to be used for that month's work.

For example, assume the total labor for the year 1914 to have been $25,600. The total overhead charges for the same year will be taken at $3690, which means that the overhead charges for any given payroll should be 14.41 per cent of the payroll. For the month of January, 1915, assume a labor cost of $6440 as against $4820 for January, 1914. This in an increase of $1620, making a total for the year ending Jan. 31, 1915, of $27,220. Assume also an overhead expense for January, 1915, of $1800 as against $1930 for January, 1914. This decrease of $130 gives a new overhead total estimated for the current year of $3560. From these two new totals a new percentage of 13.08 is reached. Taking 13.08 per cent of $6440, we have the adjusted overhead charge for January, 1915, of $840.

Similarly, each month a new rate can be obtained which will change with changing conditions, and which will provide a more accurate figure than the method commonly in use.

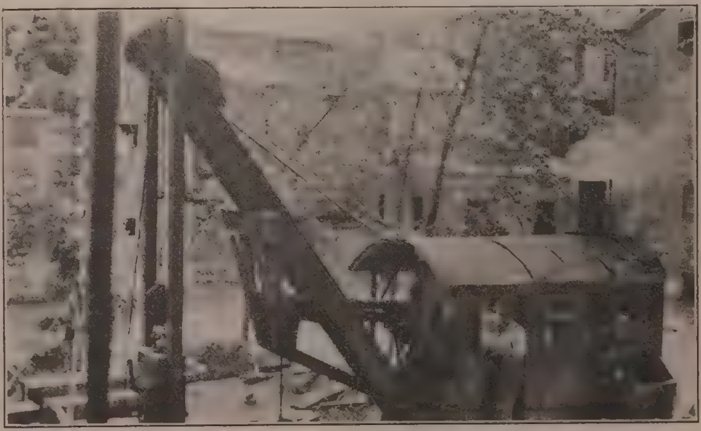
Steam Pile-Driver Operated from Boom of Revolving Shovel

By R. SICKLES

Larkin & Sangster, Contractors, Cayuga & Seneca Canal, Seneca Falls, N. Y.

THE accompanying photographs show a size 3 Union steam pile-driver hanging from the end of the boom of a Thew revolving steam shovel, from which the dipper has been removed. This outfit was used in driving piles for about 400 ft. of retaining wall. The front row of piles was battered, and the distance between the front and back rows was about 15 ft. The piles were spotted by running the shovel back or ahead on its track and by the swinging of the boom. The average length of pile used was 12 ft. One of the pictures shows a hole in a building made to allow the shovel to pass through, and later to permit the construction of the wall.

PILES FOR RETAINING WALL DRIVEN BY STEAM SHOVEL



DIPPER STICK REMOVED AND LEADS HUNG FROM BOOM

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

San Francisco Rejects Spring Valley Purchase

At Special Election on April 20 Bond Issue Measure Fails to Receive the Necessary Two-Thirds Vote for Its Passage

At a special election held April 20 the $34,500,000 bond issue for the purchase by the city of San Francisco of the Spring Valley Water Company's system failed of passage. For the ratification of the measure a two-thirds vote in favor of the proposal was necessary. The returns indicated that approximately 40,000 votes in favor of the bond issue were cast and 33,500 against, thereby defeating the project by 9000 votes. The Mayor and many prominent citizens favored the ratification of the bond issue, while Rudolph Spreckles and a number of city officials did not regard it with approval.

The situation in regard to the acquisition of the Spring Valley system was discussed in detail in an editorial on page 446 of the Engineering Record of April 10.

THE LYMAN RESERVOIR IN ARIZONA WHERE SIXTY-FIVE-FOOT EARTH DAM BROKE, KILLING EIGHT

St. Louis to Open World's Largest Mechanical Filters May 15

The mechanical filtration plant at St. Louis, the largest of its type in existence, will be officially opened May 15. The Mayor has appointed a committee representing various civic organizations to arrange for the formal opening. Edward E. Wall, water commissioner, is chairman.

Commissioner Fetherston Sues Hearst Papers for $260,000 Libel

John T. Fetherston, commissioner of the Department of Street Cleaning of New York City, began this week a suit against the Star Publishing Company to recover $260,000 damages for alleged libellous statements published in the Hearst papers, in connection with the recently vetoed bill authorizing the installation of a garbage disposal plant for New York City.

The complaint enumerates thirteen causes for action, among which are that the real object of the bill was concealed from the people, and that Commissioner Fetherston owned certain patents which would be utilized, presumably to his advantage, by the contractors for whose benefit the bill had been drafted. Another of the complaints is based on the statement that the existing refuse destructors in Staten Island had been used for show purposes, and that literature regarding them had been published at the city's expense.

Large Government Timber Purchase Made by Oregon Firm

The purchase from the Federal Government of 382,000,000 ft. of timber in the Crater and Paulina National forests in Oregon was recently announced by the Pelican Bay Lumber Company. The timber is in two limits, one on Four-mile Creek and one in the Mt. Scott territory. The stumpage price paid by the lumber company was approximately $3 per thousand feet for the Four-mile timber and $3.25 for the Mt. Scott timber. It involves a total outlay of about $1,250,000. It is reported that the consummation of this transfer means the extension of the Klamath branch of the Southern Pacific Railroad for a distance of 12 mi., and eventually an extension to a point about 20 mi. beyond Kirk. It is estimated that it will take about 10 years to cut all of the lumber conveyed in the two limits purchased.

Water Flows Over Roosevelt Dam Spillway

The State of Arizona gave itself up to rejoicing April 15 in celebration of the filling of the reservoir back of the Roosevelt dam. A legal holiday was declared. Water started running over the spillway at 8.30 p. m., April 14. It was so small as to amount to a mere trickle, and even as yet the flow over the spillway is very small.

The dam was completed in February, 1911.

Government Engineer Killed in Railway Accident

Morton L. Tower, engineer in charge of Government jetty construction work at Humboldt Bay, Cal., died April 17 of injuries sustained when a motor-driven track tricycle on which he was riding jumped the rails near Eureka. Lieut.-Col. Thomas H. Rees, Corps of Engineers, U. S. A., and E. W. Dickson, superintendent of the Pacific Engineering & Construction Company, who were riding with him, sustained injuries.

Sixty-five Foot Earth Dam Breaks in Arizona

Failure of Structure Forming Lyman Reservoir Near St. Johns Attributed to High Water from Melting Snow and Gopher Burrowings

Weakened by the inrush of water from melting snows and possibly by the burrowings of gophers at points just above previous high water, the Lyman dam, a riprapped earth embankment, 65 ft. high and 800 ft. long, forming an irrigation reservoir on the Little Colorado River, 12 miles south of St. Johns, Arizona, failed at about midnight, April 5. Eight people were drowned by the flood of water which poured through the break and continued on down the valley, washing out two smaller dams below. The total loss is estimated at between $500,000 and $1,000,000. Lamar Cobb, State engineer of Arizona, has informed the Engineering Record that there are no provisions in Arizona for State supervision or inspection of such structures as the one in question, which is part of the Lyman Land Company's irrigation system.

The Lyman dam formed a reservoir of 50,000 acre-feet capacity and was constructed of earth and rock with a puddled core-wall. The head-gate of the canal system was about 20 ft. above the river bed. At the time of the accident there were impounded behind the structure 32,000 acre-feet of water. The dam was completed in August, 1912, and was financed by Denver capitalists. The portion which washed out was directly in the channel of the stream.

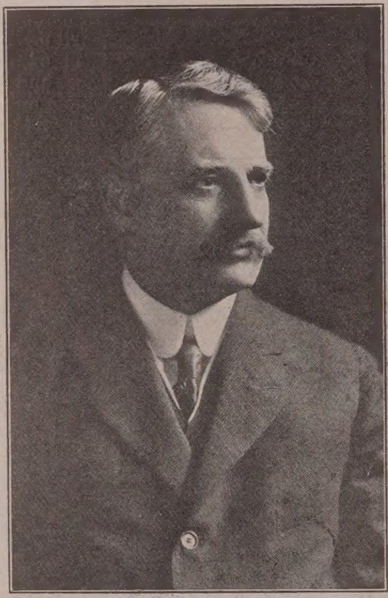
Pan-American Road Congress Invites South American Delegates

It has been decided to hold the Pan-American Road Congress at Oakland, Cal., during the week of Sept. 13, instead of from Sept. 6 to 11, as previously announced. The program will include papers on construction, repair and maintenance. It is expected that this Congress will bring together those interested in highway improvement, not only from all parts of the United States and Canada, but also from the South American countries, all of which will be invited officially to participate in the Congress. The meeting will be held under the joint auspices of the American Road Builders' Association and the American Highway Association.

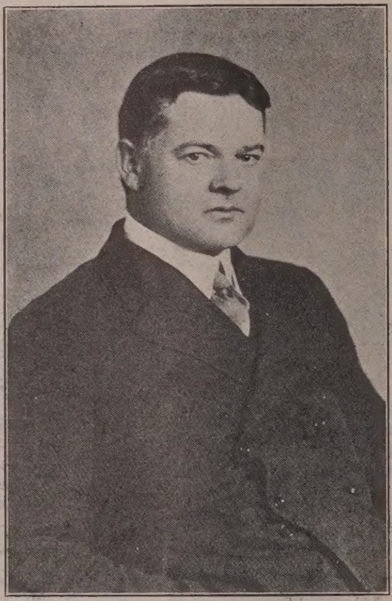
Engineers Achieve Notable Results in Organizing Belgian Relief

Two American engineers are mainly responsible for the efficient manner in which the Belgian relief work has been carried on. One of them, Lindon W. Bates, had retired from active practice after more than thirty years of engineering work, but willingly returned to labor nineteen hours a day without compensation as vice-chairman of the Commission for Relief in Belgium in organizing the work in the United States. The other, Herbert C. Hoover, stopped short in a noteworthy career to act as chairman of the commission, handling the work of distribution in the afflicted country.

Engineers Responsible for Successful Handling of Belgian Relief Work Involving Expenditure of $40,000,000



LINDON W. BATES



HERBERT C. HOOVER

Despite the fact that in the beginning it was emergency work, undertaken under most adverse conditions, there has been no hitch in the arrangements from the very beginning until the present, when the work is being carried along in almost machine-like fashion. A populous nation has been clothed and fed, largely by voluntary subscription. The innumerable small packages that had to be collected, transported and distributed can scarcely be imagined and the countless details of arrangement and organization that had to be perfected to do it can hardly be visualized, for, it must be remembered, the donations came from all parts of this country, from the smallest hamlets and from the largest cities. Over five million dollars have been paid out from the New York office in cash, or check, each month, totaling at the present time over $40,000,000.

Americans are tolerably familiar with the part of the work done in Europe. When the clothing and provisions first started to arrive, Belgium was a land without a pretense of transportation facilities; every railroad was either destroyed, crippled or occupied with the transportation of soldiers and the munitions of war. Yet the food had to be brought in, and quickly. It was a problem that took an engineer to solve, and it was solved by repairing and utilizing the war-damaged Belgian canals and bringing the food up in boats.

Lindon W. Bates

Lindon W. Bates was a member of the Class of 1879, Sheffield Scientific School, Yale University, and subsequently joined the engineering forces of the Chicago, Burlington & Quincy Railroad. From this road he went to the Northern Pacific, where he served as engineer on location and construction; later he served in the same capacity on the Oregon-Pacific and the Oregon Railway & Navigation Company. Then he entered the contracting business and executed, among the other construction works, the reclamation, from the Kaw River, of that portion of Kansas City where the stock yards now stand. Much of the work of Mr. Bates has been in the design and use of hydraulic dredges. Among others designed and built by him are the "Beta," which was built for the Mississippi River Commission in 1894 and which delivered over 5000 cu. yd. of material per hour, winning thereby a bonus of $87,000; several (electrically operated) built for the Russian Government for use in removing the bars in the river Volga, and the "Hercules," which made a demonstration of efficiency in the Suez Canal that had much to do with hastening the decision to widen that waterway. As contractor he raised the grade of the city of Galveston, involving the placing of 12,000,000 cu. yd. of material. He also made extensive studies in connection with the Panama Canal, and in 1905 published a book on the subject, in which he discussed the various solutions proposed up to that time and suggested a method of his own. He is also the author of many other technical works and papers.

Herbert C. Hoover

Herbert C. Hoover was graduated from Leland Stanford University in 1895 and worked for a time with the U. S. Geological Survey. After some mining work in this country he went to Australia as chief of the mining staff of Bewick, Moreing & Company. In 1898 he became chief engineer of the Chinese Imperial Bureau of Mines, doing extensive exploration in the interior of China, and in 1900, during the Boxer disturbances, took part in the defense of Tientsin. Later he became the representative of the bondholders in the construction of Ching Wang Taw harbor and in 1901 a partner in the firm of Bewick, Moreing & Company. Previous to the relief work he was engaged actively as consulting engineer for more than fifty mining companies, many of them owned by Belgians. He is the author of a number of technical works.

Of Mr. Bates, the Literary Digest for April 17 says: "He is an engineer in very fact, bred to the solution of hard problems, to the direction of difficult enterprises, and the accomplishment of difficult projects which require a clear head and executive gifts of the highest order." What has been said of Mr. Bates might just as fittingly be applied to Mr. Hoover.

Cincinnati Ready for American Waterworks Convention

Program for Thirty-fifth Annual Meeting Has Been Completed—Superintendents Day and Session of New Chemical and Bacteriological Section Are Features

Arrangements have been practically completed for the thirty-fifth annual convention of the American Waterworks Association to be held at the Hotel Gibson, Cincinnati, May 10 to 14. In addition to the usual program of technical papers two special sessions are scheduled for May 13, one for superintendents and the other for the newly organized chemical and bacteriological section. The entertainment features include two dances, a boat ride on the Ohio River and inspection of the filtration plant, and a glee club concert.

Among those who will present papers at the meeting are Edward Bartow, Langdon Pearse, John W. Hill, D. D. Jackson, J. W. Ellms, C. P. Hoover, C. P. Birkenbine, Philip Burgess, W. F. Monfort, Francis F. Longley, W. H. Frost, J. M. Caird, W. P. Mason, N. S. Hill, Jr., and W. W. Brush.

Practically every phase of the waterworks problem is represented in the program of papers. These will deal with filtration, chemical treatment, distribution and high pressure fire systems, valuation, franchises, rainfall and runoff, standards of purity, disinfection, operating methods, sedimentation, pipe, and maintenance of distribution systems.

At the morning session of May 11 the reports of the following committees are scheduled for presentation: Electrolysis, cast-iron pipe specifications; wrought-iron pipe specifications; depreciation; stream pollution; hydrant and value specifications; water consumption; standard fittings for water meters, and plumbing code.

Sheriff Advertises Sale of Yakima Irrigation Canal System

The sheriff of North Yakima, Wash., has advertised for sale on May 8 the Yakima Valley Canal Company property, including water rights and a canal upon which $100,000 has been expended in improvements. The system supplies the Nob Hill suburban fruit district and the sale is advertised, it is announced, to satisfy a judgment of $18,500 and costs.

The judgment against the company was secured on a charge of failure to supply sufficient water for nursery stock. The Supreme Court in a five to four decision upheld the judgment, but Justice Chadwick, in a dissenting opinion, held that the plaintiff had no right to recover, as the evidence showed that all users suffered shortage of water that year. He said further that the company was a municipal corporation and that if one could recover from the company each could, the result being that none would. Chadwick held the judgment could not be realized upon.

Scope of Third and Fourth Volumes Engineering Congress Transactions

The scope of the third and fourth volumes of the transactions of the International Engineering Congress, which will be held in San Francisco in September, have been outlined. The third volume will comprise a series of papers on municipal engineering. The field will be treated under nine topics covering the general subjects of city planning; streets; drainage; disposal of waste; water supply; protection against fire; transportation; public utilities, and rural highways. Approximately twenty papers, prepared by authors representing six different countries, are expected for this volume. Included in these there will be one on "City Planning," by Nelson P. Lewis, and one on "Traffic in London," by Sir Albert Stanley. The volume will be illustrated with charts, diagrams and halftones, together with discussions contributed by leading American and foreign engineers.

Volume 4 will comprise a similar series of papers on railways and railway engineering. This field will be treated under seven principal topics covering the relation of railways to social development; present status of railways; economic factors governing building of new lines; location; physical characteristics of road, including track and roadbed; bridges; tunnels; terminals; construction methods; signals; road equipment, including motive power other than electric; rolling stock in general; floating equipment, and electric motive power in general. About twenty-seven papers are expected for this volume, prepared by authors representing nine different countries.

Oppose Dam Across Illinois River at Starved Rock

As a result of an objection by the city of Ottawa, Ill., to the building of a 22-ft. dam across the Illinois River at Starved Rock, 10 miles below Ottawa, as outlined in the proposed Illinois waterway plan, a conference was held by Governor Dunne in Ottawa, April 15. The session was attended by Lyman E. Cooley, L. K. Sherman and E. J. Kelly, the engineers who drafted the plan, members of the State Assembly and representatives of the city. The conference failed to reach an agreement and another meeting was held April 17, at which a modified plan of lowering the dam 6 ft. was submitted. Ottawa refused to accept the plan and was given two weeks to get disinterested engineering advice on the matter.

Ottawa citizens proposed that the height of the dam should be 10 ft. less than that contemplated. It was contended that the effect of the 22 ft. dam would be to raise the water at Ottawa 15 ft., which would destroy the sewerage system of the city and cause great damage by overflowing adjacent lands.

The State engineers said that if the mouths of the outlets of the sewers were relaid at the proper grade (which they are not now) to conform with the sewer system of the city proper the whole system would then lie above the back water caused by the dam. The State engineers further declared that if the dam were lowered as much as demanded the State would lose the benefit of a valuable water power, which probably would yield sufficient revenues to pay a large return on the entire waterway investment. The State would compensate Ottawa for whatever damage would be caused.

Western Society Engineers to Investigate Wind Stresses

Investigation of the possibilities of standardizing the solution of wind stresses in office buildings is to be made by a committee of the Western Society of Engineers, which has as its members Prof. Albert Smith, chairman; Prof. W. M. Wilson, H. J. Burt, N. M. Stineman, J. G. Giaver and Albert Reichmann.

Professors Smith and Wilson have developed by different procedures two exact methods for the solution of wind stresses in a typical office building frame. When compared with the approximate methods commonly used in actual work and advocated by several well known engineers, discrepancies appear in the results obtained, sufficient, if correct, to prove that the approximate methods as now used are at too great variance with methods in which actual conditions are determining factors. From the exact methods two new approximate methods which should increase the degree of safety in design have been developed. These two methods check and it is the work of the committee to develop if possible a practical method of solution, the results of which will approximate those obtained by the exact methods which is by far too laborious to be used in actual work. All those interested in the work should communicate with Prof. Smith, Purdue University, Lafayette, Ind.

160 Miles of Barge Canal to Be Put in Use Next Month

With the opening of the Erie and Oswego Canals in New York State May 15, following that of the Champlain Canal May 1, more than 160 miles of the new Barge Canal channel will be put in commission, according to an announcement by Gen. W. W. Wotherspoon, superintendent of public works. This will include 100 miles along the Erie Canal (17 miles between Waterford and Rexford Flats, 20 miles in Wayne County and the remainder between Rochester and Tonawanda), 31 miles on the Champlain Canal and 35 miles on the Oswego Canal. Eleven of the new locks on the Erie Canal, six on the Champlain and all seven on the Oswego will be in operation. The new Barge Canal entrance at Waterford will be used, but the old canal from Waterford to Albany will be retained in its present condition.

Oregon's Water-Power Tax Abolished

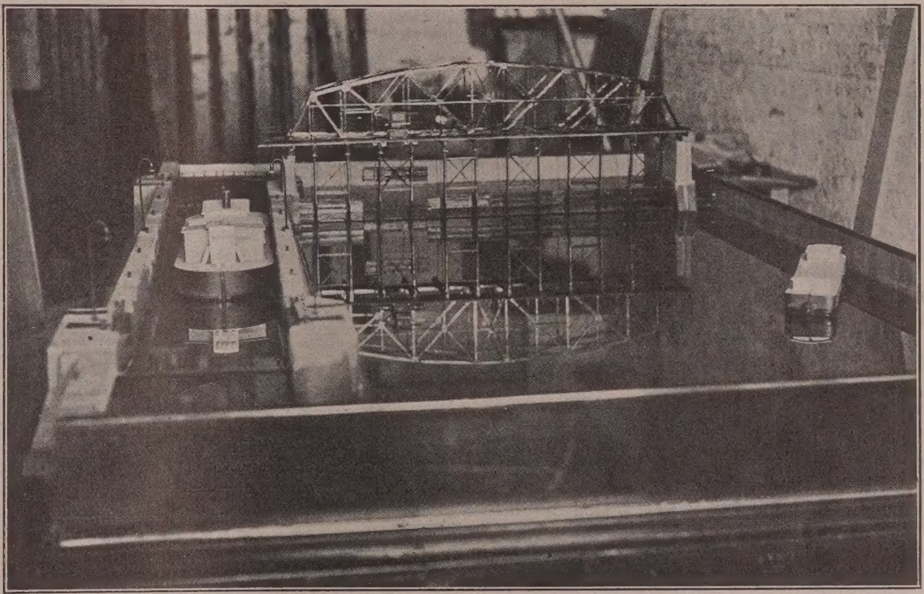
The special annual tax on new water-power projects, as provided by the Oregon Legislature in 1909, has been abolished and the license fee on old and new projects alike reduced to a nominal sum by the Oregon Legislature of 1915. The law, according to information received from John H. Lewis, State engineer of Oregon, required the payment of an indefinite tax of from 25 cents to $2 per horsepower per year by each user of water for a power development made subsequent to May, 1909. This tax rate could be adjusted between these limits at any time by the State authorities.

The law was found to yield little revenue, and seemed to discourage development. While existing power projects were exempt from this special revenue tax, they were required to pay a license tax for regulation purposes, graduated as follows: 10 cents for each theoretical water horsepower claimed up to 100; 5 cents for each horsepower from 100 to 1000, and 1 cent for each horsepower claimed in excess of 1000. Public plants, as well as those of less than 25 horsepower capacity were exempt. These fees amounted to about $4000 per year, which was used in gathering stream flow records and other data to encourage development.

New York Barge Canal, in Miniature, Operates at Exposition

A special effort was made in planning the New York Barge Canal exhibit for the Panama-Pacific Exposition to make a display which would give a comprehensive idea of the whole undertaking and, at the same time, illustrate its distinctive features. As finally prepared, it consists of working models, oil paintings, motion picture and lantern slide views and a collection of photographs.

The largest model shows the eastern end of the Barge Canal, from its junction with the Hudson River near Waterford to its entrance into the Mohawk River about midway between Cohoes and Crescent. The stretch of canal which this model represents contains the greatest flight of high-lift locks in the world; five locks, located within a distance of about a mile and a half, elevating boats through a height of 169 ft., or within 1 ft. of twice the total lift of the Panama Canal from sea-level to summit. The model is 27 x 10 ft. in size and shows some three or four miles of canal and the adjacent territory for a mile in width.



MODEL OF BRIDGE-TYPE MOVABLE DAM, NEW YORK BARGE CANAL

Another model represents a typical Barge Canal terminal. It measures about 10 x 6 ft. and shows how material is unloaded from boats to warehouses.

Model of Siphon Lock

There is a model, measuring 20 x 3 ft., of a siphon lock with a 25-ft. lift. In this model boats are passed through the lock. To show the unusual method of filling and emptying this type of lock, the wall is cut at one of the siphons and the opening covered with transparent celluloid. The novel device of vacuum tank for starting the flow of water and the flow through the siphon and culvert are thus clearly seen.

Another model, about 11 x 7 ft. in size, represents a movable dam of bridge type with a lock beside it. It illustrates the provision for unwatering a lock that is a distinctive feature of the Barge Canal. A centrifugal pump is mounted on the lock wall and the water can be drawn from the lock chamber after the buffer-beam has been swung and the needle-dam inserted. One of the closures of the dam is operative. A miniature electric winch, running upon a track on the bridge floor, stops over this opening and lifts first the gate, allowing the impounded waters of the upper pool to pass, and then raises the upright to a horizontal position beneath the bridge floor. The operations may be reversed and the pool again formed.

There are also models of a siphon spillway and a dam with an automatic crest.

News of Engineering Societies

The Engineers' Club of St. Louis heard T. L. Condron, a consulting engineer of Chicago, speak on "The Destruction and Reconstruction of the Edison Phonograph Works" at a meeting held in that city April 21.

The Engineers' Society of Pennsylvania held its regular monthly business meeting in Harrisburg April 16. J. Horace McFarland, president of the American Civic Association, spoke on "Seeing Pennsylvania First."

The Engineers' Society of Western Pennsylvania will meet in Pittsburgh, May 4. F. M. McCullough, assistant professor of materials, Carnegie Institute of Technology, will speak on "Local Sands and Gravels as Aggregates in Concrete."

The Albany Society of Civil Engineers will hold a meeting in that city, April 27, at which R. H. Sargent topographical engineer, U. S. Geological Survey, will speak on "Methods Employed by the United States Geological Survey in Executing Topographic Surveys."

Personal Notes

L. E. Stevens, city engineer of Grand Rapids, Mich., has resigned.

R. J. Cunningham has been appointed State highway commissioner of Pennsylvania.

Nelson Cunliff, superintendent of construction of the Park Department of St. Louis, has been appointed commissioner of that department.

Clyde Potts, consulting engineer of New York City, has been appointed a member of the Board of Health of the State of New Jersey.

Homer Hamlin has not resigned as city engineer of Los Angeles. The notice of his resignation that appeared in these columns April 10 was an error.

F. W. Albert was appointed engineer in the water department of Washington, Pa. He was formerly assistant engineer in the department, having served since 1901.

Peter Hauck, of Harrison, N. J., has been reappointed a member of the Passaic Valley sewerage and drainage commission by Governor Fielder of New Jersey.

The Holbrook, Cabot & Rollins Corporation and George B. Fry, contractors, have moved their offices from 331 Madison Avenue, New York City, to 52 Vanderbilt Avenue.

W. H. Alderson has been appointed chief draftsman of the St. Paul Union Depot Company, now starting the construction of a new passenger terminal at St. Paul, Minn.

O. J. Dempster has resigned from the office of city engineer of Little Falls, N. Y. It is reported that he will enter the service of the New York State Highway Department.

M. N. Baker, an editor on the staff of "Engineering News" and for 25 years a member of the Board of Health of Montclair, N. J., has been appointed a member of the New Jersey State Board of Health.

G. D. Pratt has been appointed conservation commissioner of the State of New York. This is a newly created office, which takes up the duties of the old Conservation Commission of three members that was abolished by the last Legislature.

Carl K. Wirth, who has been for the past year at the gas works of the U. S. Steel Corporation at Sparrow Point, Md., has become connected with the Research Corporation of New York City. His work with this company will be along the line of chemical engineering.

H. S. Loeffler and M. B. Lagaard, research assistants in the department of experimental engineering of the University of Minnesota, have been given a leave of absence for a brief period to assist in the test of some steel bridges and viaducts in Montana for the Northern Pacific Railroad.

George I. Oakley, lately resident engineer in charge of New York State Barge canal construction in Little Falls, has been appointed city engineer of that city. He was graduated from Union College in 1902 and has engaged in building construction, sewer work, topographical surveys, railroad location and construction and canal work since that time.

William J. Orchard has resigned as assistant sanitary engineer with the New Jersey State Board of Health to become associated with Wallace & Tiernan Company, Inc., manufacturers of chlorine control apparatus and sanitary engineering specialties, 136 Liberty Street, New York City. Mr. Orchard is a graduate in sanitary engineering from the Massachusetts Institute of Technology and previous to his connection with the New Jersey State Board of Health he had been in the engineering departments of the Massachusetts State Board of Health and of the Metropolitan Water and Sewage Commission of Massachusetts.

James B. Girand has been appointed city engineer of Phoenix, Ariz., succeeding G. S. Foster, Jr., resigned. Mr. Girand received his education in engineering at the Agricultural and Mechanical College of Texas. In 1891 he was county surveyor of Moore County, Tex., and from 1892 to 1895 was district surveyor of Oldham Land District, Texas. In 1897 he engaged in railway work and attained the grade of assistant chief engineer on the Santa Fé & Grand Canyon in 1899. From 1901 to 1905 he was engaged principally in mining work and from that time until 1907 was engaged in private practice as a consulting engineer and served as city engineer of Prescott, Ariz. In 1909 he became territorial engineer of Arizona and later entered private practice as a consulting engineer in Phoenix.

Alfred F. Harley, consulting engineer of Jacksonville, Fla., was elected president of the Florida Association of County Surveyors at the annual meeting of the association at Gainesville, April 16 and 17. Mr. Harley was born and educated in England and came to this country in 1877. He engaged in railroad work as draftsman in the service of the Zanesville & Ohio and the Shawnee & Muskingum River until 1888, when he engaged in preliminary work in connection with locks and dams on the Muskingum River, Ohio. In 1900 he went to Jacksonville as assistant engineer and a year later became city engineer. During the period he occupied this office he also engaged in a private practice and was chief engineer for Duval County in the construction of a 5-mi. boulevard and designing and consulting engineer for the sewerage and waterworks system of Miami.

Obituary Notes

A. B. Andrews, first vice-president of the Southern Railway, died in Raleigh, N. C., April 17.

Louis V. O'Neill, for many years a building contractor in Chicago, died April 19 in that city.

M. P. Neff, an assistant engineer in the Department of Public Service of Cincinnati, died in that city April 12.

John M. Sherrerd died at Easton, Pa., April 15. He was assistant to the president of the Kennedy-Stroh Corporation of Pittsburgh and was engaged in the iron and steel manufacturing business for many years.

Byron Holley died in Rochester, N. Y., April 14. He practised as an engineer for many years, principally in connection with canal construction. Much of his work was on the old Erie Canal, in the service of the New York State engineering department.

Civil Service Examinations

New York State—Examinations will be held on May 15 (application blanks must be executed and filed on or before May 7) for positions of inspector of construction for several counties with the State Department of Highways. Salary $3.50 to $4.50 per day. Applicants must have practical experience in the building of roads or of other public or private work, either in construction or maintenance, and must be residents of the counties to which the positions are assigned. For application blanks address the Civil Service Commission, Albany, N. Y.

Philadelphia—Examinations will be held in Room 976, City Hall, Philadelphia, on the dates given, for the positions named below. Applicants must be citizens of the United States and residents of Philadelphia, unless otherwise specified. Applications should be executed and filed three days prior to date of examination.

ARCHITECTURAL DRAFTSMAN, salary $1200 to $1500 (inclusive) per year, April 29 and May 5. Applicants must have 1 year's experience and must be 21 years of age.

ASSISTANT ENGINEER (abolishment of grade crossings), salary $2500 per year, May 3 and 4. Candidates must be 25 years or over and should have a technical training. They must have at least 5 years' field experience on railroad construction and also 2 years' in masonry construction; such as concrete, brick and stone bridge abutments, retaining walls, buildings, sewers or other municipal underground structures. They must be familiar with up-to-date methods of keeping and making out progress reports and cost data and must have executive ability and experience to handle and direct men in the field.

ARCHITECTURAL DRAFTSMAN, salary $900 to $1200 per year, May 3 and 10. Applicants must have knowledge of architectural composition and 6 months' experience, and must be 21 years of age.

ARCHITECTURAL BRIDGE DRAFTSMAN, salary $1500 per year, May 3 and 10. Applicants must be 21 years of age and graduates of a technical school. They must have 1 year's experience.

RAILROAD DRAFTSMAN, salary $1600 per year, May 3 and 10. Applicants must have knowledge of track construction, classification and layout and materials used thereon, and must be 21 years of age.

TRANSITMAN, salary $900 per year, June 3. Applicants should have practical experience and must be 20 years or over.

SECOND ASSISTANT, salary $1000 per year, June 4. Open to residents of Pennsylvania. Applicants must have technical training and 6 months' experience in running transits, and must be 21 years of age.

ASSISTANT ENGINEER, salary $4000 per year, June 4. Residence waived. Candidates must have at least 5 years' experience in highway work; must have a technical training or its equivalent and thoroughly understand organization, and have experience as an executive. They should have a knowledge of the different types of pavements, unit cost keeping, contracts, specifications, etc., and should know how to deal with contractors. Request for application blanks should be made to the Civil Service Commission, City Hall, Philadelphia.

Examinations Previously Announced

Date		See Eng. Record
April 28-29	Surveyor - draftsman, U. S. Government service; salary $1200-$1500	Mar. 20
May 1	Utilities Investigator State of Illinois; salary $100 to $150 per month	Apr. 3